Mónica Altamirano

Innovative Contracting Practices in the Road Sector

Cross-national lessons in dealing with opportunistic behaviour

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Mónica Alejandra Altamirano

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Cover illustration: Ploughing Trials on the Porvoo Road in February 1928. From that time the road from Helsinki to the Vyborg county border was regularly kept open. Examination of the "Vasa"-plow, a Brockway rental car pushes the plow.
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A los niños de mi país, en especial Nené (Nicolas) y mi chiquitita (Isabella)

Acknowledgements

My interest for public policy started in my early university years while being student assistant of my university rector; by doing statistical analysis of the Nicaragua Living Standards Measurement Survey of 1998 on the issue of education policy. This interest grew even further while working on the Nicaraguan Ministry of Education and Culture (MECD).

The idea of being able to influence public policy decisions on basic education and through it to make a contribution towards a change in our basic education system and therefore a change in the way education opportunities are distributed, simply captivated me. This is exactly what moved me to pursue a master on policy analysis.

The experience at the Ministry of Education, particularly concerning the role of international cooperation, made me aware about the practical difficulties of transplanting policies that are successful somewhere else to our own particular institutional context. Consequently, when the opportunity of doing research on this topic -although for a completely different sector- was offered to me, I did not hesitate in taking it.

I was supposed to be defending this thesis on October 16th 2009 however I fell ill after the delivery of Isabella, my wonderful daughter. In the meantime, between the delivery of my thesis and the planned date of the defense, something happened that changed all my plans. I had the bad -or should I say the good- luck of experiencing a touching and far-reaching experience. A so-called postpartum depression, due to which I got to see and experience twice what most of us experience only once; the feeling that someone just put the lights off and your life is over. This experience has also changed my life for good, because against all fears and above all doubts I have explicitly decided to believe, to have faith, and to dare to live in the hope that each day brings a new chance to be happy and to make others happier.

Feelings and hope do justify life. Without feelings and hope there is no reason to live, given the inevitable truth of death, the adventure of life seems and feels a real nonsense. Because even sadness and pain are better than no feelings at all, since even from sadness we taste the good feeling of love and sad times are lightened by hope.

Postpartum depression has been by far the greatest challenge I have ever faced. Mainly because I felt all the time like fighting it alone -not even my faith seemed capable of breaking into my loneliness.

The paradox of depression and the recovery from it is that one endures each day only in the hope of ever being one self again, of being happy again; even though one does not have and in fact cannot feel hope. I really do think we should learn in school about depression, just as we learn about physical sicknesses such as the flu or polio, and be ensured that there is a cure to it.

It may seem slightly strange or inappropriate to discuss these things here, however I feel it is important. First, because part of the problem is too often shame and silence and second, because the most revealing moment of my life may have happened in a "positive" instant in the middle of all these deeply somber and extremely dark days.

This special instant I understood as never before what it really is that gives meaning to life (for the poor and the rich alike) even if it has an end. *The meaning of life is the mystery of love*. That love, that feeds us and is true bread ("verdadero pan") to our spirits; those minutes, even if scarce that we feel deeply and genuinely happy -and blessed- and all the feelings we treasure in the time in between are the footprint we leave and the real meaning of our existence. This instant I saw clearly I believe a God understood as that infinite force that is love and connects all of us as brothers in unity, and makes us do the extra mile for the other, without any clear economical or rational reason. This may be the main difference between the assumptions in my personal life and my research, where I openly suspect people of opportunistic behaviour.

And today, it is certainly one of those days I feel genuinely and greatly blessed. I have to say, that I am still here today and finally up on my own feet, preparing together with Pepijn the last details of this book and of the defence with so much pleasure; thanks to my family and the many good friends that supported me to survive the darkest and most painful days of my life. I would not be here without their care; first of all of my husband Pepijn -who was incredibly strong to take care of Isa and me; my mother-in-law Elly -who gave me the necessary routine and trust in my recovery; my father in law Jan -who kept explaining to me that it were my hormones that were taking over my reason; my own mother -who came just in time to give my little Isa the warmth I could not give her; my nearest friends here in the Netherlands (Trudy, Adriana and Leslie) and last but not least, my community at large -the International Student Chaplaincy- for their prayers and especially Reini, Waltraut, Henk and Father Avin.

Yes, just right before my depression I used to think that these four years of PhD was the most lonely project I had ever undertaken, but nothing is less true. I was only able to achieve it thanks to the support and love of so many persons; not only during my years in the Netherlands, but much earlier since my childhood and youth in Nicaragua. During those years and in those places where my roots really are and where the pillars of the career I have now were built.

Primero que todo, gracias a Dios -mi único y verdadero Padre- y gracias a esa gran certeza que el me dió desde que era una adolescente, "yo me haré cargo". Es esa certeza, esa confianza la que me ha traído hasta aquí y la que me ha permitido ser

auténtica y fiel a mi misma, aún cuando iba contra corriente. Y hoy no tengo más que decir que gracias!

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I will certainly miss life at University. My daily philosophical and sometime rather passionate (meaning me or Michiel being upset!) conversations with Michiel about what scientific research is really about and about life after the PhD. Our peer group meetings with Martijn, Bauke, Michiel and Robert and of course the fun borrels in the improvised 4th floor pub, after the mini defences. And surely, the extra-curricular activities always organized by the axis; Anish -the pioneer-, Leslie, Austin and me. I still remember Anish shouting "Pepijn, Pepijn", that afternoon playing Ultimate Frisbee with Chad Foster, our visiting researcher from MIT.

E&I has certainly been a home for all these years. All the "taart" even without a clear reason to celebrate, the various songs that have accompanied us from being sin-

gle to being married and from being students to being Doctors; and the long-awaited Sinterklaas celebration to which I could finally come along with my own kid. And though it is difficult to call names, cause you all made it such a special place, I especially would like to thank Ivo Bouwmans, Petra Heijnen, Laurens de Vries and their partners Myriam, Joost and Deborah, for making it such a warm place.

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As Don Silvio, my first professor and boss taught me to disregard the fact or disadvantage of being a women and not having an impressive last name (un apellido de "alcurnia") in a somewhat chauvinist and classicist society; you two -Margot and Paulien- have helped me to overlook the possible disadvantage of been an emigrant (allochtoon) could mean in a highly densely populated and increasingly sensitive Dutch society; and overcoming these barriers and daring to go after my dreams and ideals.

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Mónica A. Altamirano
Delft, April 5th 2010

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Chapter 1

Introduction

1.1 Background and motivation of research

Over the past fifteen to twenty years, the world has seen a proliferation of innovative approaches for the delivery and financing of public services, as part of a growing interest in private sector involvement. This interest has been prominent in the procurement of public-use infrastructure such as roads, rail, water and buildings, and in the use of Public-Private-Partnerships (PPPs) as project delivery method. PPP projects represent more than a trillion dollar investment in planned or completed infrastructure projects worldwide since 1985 (PWF 2008).

The shift towards market forces started in the United States in the 1970s, with rail, power and telecom deregulation. During the mid-1980s, Spain, Chile, New Zealand and, most actively, the United Kingdom, expanded the portfolio to encompass new risk-sharing arrangements for the delivery of public works infrastructure projects and services (AECOM Consult 2005).

Since the late 1980s, PPPs have come to the fore in various countries around the world in the provision of infrastructure (AECOM Consult 2005). In the transportation sector this development has come along with a revival of interest towards the old concession model of toll roads, who had been out of favour for many years.

In all sectors and most countries worldwide, the growing interest towards PPP approaches or the search for alternative financing and delivery methods, has been mainly triggered by the increasing gaps between infrastructure financing requirements and revenues. PPPs are seen as a way to expedite critical infrastructure that may otherwise not be built. They are increasingly attractive to governments seeking financial discipline, as public agencies are able to deliver these new facilities using private sector resources without inevitably committing public debt or equity (AECOM Consult 2005). The need for additional sources of financing is particularly high in the transportation sector, which faces the burden of funding almost exponentially growing transportation

infrastructure needs in this global economy.

Nevertheless, the increasing interest in involving the private sector in the procurement of public services and infrastructures is not solely based on the need for alternative sources of financing. Other reasons often mentioned for the adoption of these innovative delivery and financing methods are:

(1) The private sector has certain advantages over the public sector, such as the presence of management skills and the capacity to create synergies between different infrastructure life-cycle phases (e.g. design, construction and operations). This may result in savings in total life cycle costs of a facility. Moreover, the private sector is often more innovative,
(2) The new incentive schemes (i.e. lump sum or fixed price contracts) being applied are expected to reduce the frequent problems encountered in construction projects, such as cost overruns and delays.
(3) Some of the ownership risk on large infrastructure is transferred to the private sector, which is better equipped to manage risks than the public sector.
(4) If the private sector role is expanded, it is expected that the public sector will be able to focus its technological, managerial, and financial resources to leverage scarce public funds and expedite the delivery of a project and/or services in a more cost-effective manner and with carrying a reduced share of risks.

In summary, to governments Public-Private Partnerships (PPPs) represent the potential to accelerate project delivery, operations, and maintenance in a more cost-effective manner, enabling public infrastructure administrators to effectively "do more with less" (AECOM Consult 2005).

The term PPP is often used by authorities to refer to project delivery methods that involve private financing of infrastructure for a long term, such as Design-Build-Finance-Maintain (DBFM) projects or concessions. However, understood in its wider sense the term PPP covers an ample variety of project financing and delivery approaches. PPP projects can involve a wide range of responsibilities and risks for the public and private sector partners. The nature and extent of private sector involvement in PPP projects can range from long-term service contracts to full financing, development operations and preservation, with the private sector taking increasing responsibility for various functions comprising the infrastructure asset life-cycle, such as Manage, Design, Build, Operate, Maintain, Finance and/or even Own.

Other terms often used for this whole gamma of out-sourcing approaches are: innovative contractual arrangements and/or innovative project delivery and financing methods. What distinguishes these approaches from traditional contract approaches to infrastructure development is the greater responsibility and risk taken by the private sector partners in exchange for an adequate return on their investment in the project or coverage of their costs (AECOM Consult 2005). Some of these contracts do transfer financial risks to the contractor, while others only transfer greater responsibility and risks for project or service delivery.

The transfer of risk and responsibility to the private contractor goes naturally hand in hand with delegation of control, the transfer of additional decision rights in determining how the project or task will be completed. As a result of these two characteristics, transfer of risk and of decision rights, the potential of PPPs also brings a number of challenges with it as the complexity of regulating and managing such contracts only increases.

The complexity and difficulty of drafting proper contracts becomes apparent from the large differences in results obtained by different countries. Especially with regard to private financing initiatives, impressive outcomes have been achieved by countries like Australia and Chile. Meanwhile, the 1990s road concession programme in Mexico has become known for its catastrophic outcomes, as it resulted in massive government bailout[1]. A recent report comparing the performance of PPP projects in Australia with traditionally procured infrastructure projects, states: "PPP projects provide far greater cost certainty than traditional contracts and there is little variation in cost of a PPP project after the contract is signed" (Duffield 2008, 25).

The results from this statistical analysis of project costs indicate that PPP contracts had an average cost escalation of 4.3% post contract execution compared to traditional projects that had an average cost escalation of 18.0% for the same period. However, the road concession programme in Mexico, that awarded 52 projects between 1987 and 1995, resulted in construction cost overruns averaged 25% and average actual revenues of about 30% below forecasts (only 5 projects met or exceeded targets) (Hodges 2006). The government was forced to take over 23 projects and paid outstanding debts to Mexican Banks (about US$ 5 billion) and to construction companies (about US$ 2.6 billions).

The most difficult task is to arrive at a balanced and acceptable sharing of responsibilities, risks and rewards together with the private sector. Government expectations of the savings to be achieved through innovative contracting arrangements have resulted in many cases in biased optimism on both sides. The problem is that in many cases, the outcome of excessive optimism is renegotiation (Estache et al. 2000). As a result of unrealistic and aggressive bids, a large number of projects face renegotiation (Queiroz 2007).

After more than a decade of experience, the validity of some PPP models has come to be questioned, mostly because of the very high incidence of renegotiation (Guasch et al. 2008). Renegotiations are often a replay of the initial negotiation with a different distribution of information between the public agency and the responsible contractor that gives advantage to the latter. Besides, as the contractor is placed in a monopolistic position at the time renegotiations take place, they normally result in higher costs. Other problems faced in the implementation of long term PPPs are excessive litigation and private sector tendency towards rent seeking and inefficiency.

[1] Bailout refers to the act of loaning or giving capital to a failing company in order to save it from bankruptcy, insolvency, or total liquidation and ruin.

To successfully conclude a PPP project is a challenge. An effective design of the contract before the project start is crucial, since often there is little more for a public agency to do than ensure that all involved parties comply with their contractual commitments (Estache et al. 2000).

Besides, the magnitude of this challenge is noteworthy, as the use of PPPs for infrastructure projects is widespread around the world. No less than 2,706 projects of all kinds have been planned since 1985, of which 1,524 have been financed, according to the PWF's "International Major Projects Survey" (PWF 2008). This includes $1,188 billion in projects planned since 1985, about half of which, or $585 billion, had been completed or financed by October 2008.

More than a third of the public-use infrastructure planned (roads, rail, water and buildings) since 1985, or completed by October 2008, concerned road projects, including highways, bridges, and tunnels. On a worldwide basis, road has been the largest category of infrastructure using private financing through a public private partnership arrangement. From 1985 till October 2004 - roads represent 39% of the total number or projects (1,046 out of 2,706) and 48% of total in billions (with US$ 580.3 billions)[2]. Europe has the largest PPP infrastructure programme in terms or road and rail project costs. Asia has the second largest rail programme and Latin America the second largest road programme. The European road programme amounts to $298,9 ($136) billions versus $91,6 ($56,3) billions of the Latin American road programme; planned (funded) cumulative since 1985 till October 2008. The European rail programme amounts to $120,8 ($59) billions, versus $100,9 ($54,9) of Asia and the Far East.

One way contribute to the solution of this problem and to expedite and lower the costs of the transition towards this new paradigm of contracting is to learn from pioneering countries in the development and administration of these contracts. The research proposed aim at drawing such lessons for the road sector and finding inspiration in three pioneering European countries.

1.1.1 Road sector reform

The environment of the public sector has changed significantly in the last decades. The 1990s were a time of strident Anglo-North American insistence that public utilities were best suited to deliver self-sustaining competition and price reductions (Arentsen and Künneke 2003). In the road sector, the change to the so-called New Public Management[3] (NPM) paradigm has meant in most cases important structural reforms

[2] Percentage of financed projects is 32% of the total number of projects (500 out 1524 projects) and 45% of the total in billions ($265.2 out of $585.4).

[3] NPM refers to a group of notions that prescribe a new way of operation for the public sector. The goal of this new administrative approach is to improve the performance of the public sector by paying special attention to accountability and flexibility in government practices and procedures and by reducing the role of the government.

of many public road authorities around the world; from direct providers of the infrastructure to client organizations responsible for tendering all phases of road construction and maintenance activities (PIARC 1995, Talvitie 1996, Parkman 1998, Talvitie 1999). This process of moving from an in-house organization to a client organization is often referred to as the privatization process of a governmental agency (Madelin and Parkman 1999, Pakkala 2002).

The process is described as existing of seven phases that increasingly separate the client-related aspects of road management from its service-providing parts (see Figure 1.1). In this terminology, the client represents the principal, for instance the public agency ordering the services, while the provider is the agent, the company that delivers the requested services. This process is accompanied by a gradual opening of the market (liberalization), the selling out of the public provider (privatization), the creation of a road fund from which investments exclusive to roads can be made and eventually even the privatization of the public agency acting as a client. However, these last two phases of the model have not yet been implemented anywhere.

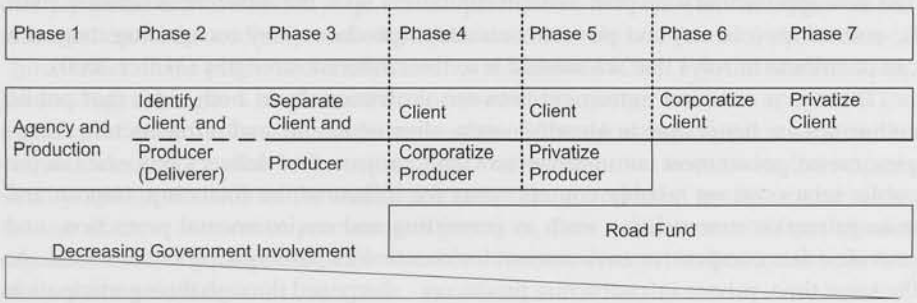

Figure 1.1: *The seven phases in road reform (Source: Talvitie 1996, 100, adapted by Pakkala 2002, 17)*

1.1.2 Innovative contracting and procurement practices

Road (structural) reform is only a first stage towards the implementation of the principles of New Public Management, which stress that private involvement enhances efficiency and effectiveness of public services. This first stage lays out an institutional framework for the commercial management of roads. It addresses the question whether to keep services in house or to buy them, but things do not stop there. Once the decision is made to outsource all works, the question remains how to organize these work packages and outsource them in the most efficient way. Here the tendency is to use innovative contracts that transfer more risks to the private sector and where a service, instead of a product, is being bought.

It is important to clarify that a structural reform of the public road authority is

not a necessary step for the introduction of innovative contracting practices. Many road authorities around the world use such innovative contracts without first having implemented a reorganization; even if they still perform a significant magnitude of maintenance tasks with in-house personnel[4].

The public obligation of providing a transportation network can be divided into four different kinds of tasks:

- capital projects: the construction of green field projects or new roads;
- routine maintenance: daily activities that ensure the continuous availability of the road, like roadway and shoulder maintenance, drainage and winter maintenance;
- periodic maintenance: the management of pavements and the planning of activities required to return the state of the road to its original condition by repairing damages and thereby substantially altering the asset condition;
- operation of roads, which mainly includes incidental traffic and safety services.

The new approach in road procurement capitalizes upon the differences between public authorities (clients) and private contractors (producers) by recognising that each can contribute in ways that are amenable to their inherent strengths (Miller 2000).

There is a common agreement between professionals on both sides that public authorities are better able to identify needs, align economic and infrastructure strategies, create government commitment to viable projects and delivery processes in the public sector, set up reliable commitments for infrastructure financing, impose and manage market externalities, such as permitting and environmental protection, and provide a fair competitive environment for contractors participating in the sector. At the same time, private infrastructure producers - sharpened through their participation in competitive markets- are considered best at contributing efficient (technical) competencies, providing independent checks of the technical and economic viability of projects and providing alternative sources of financing for projects that are potentially self-sufficient.

Four trends are perceived in road contracting (Altamirano and Haraldsson 2005, Altamirano and Herder 2006). Firstly, projects are contracted for the whole life cycle of the road. Secondly, contractors are given increasingly more freedom of design (Herk et al. 2004), as the indicators used for monitoring their work become less operational and more performance based (Cervera and Minchin 2003). Thirdly, more projects are financed by private investors (Miller 2000). Fourthly, contracts tend to be granted for the longer term (Altamirano et al. 2007).

Not until the last 15 years, have these alternative project delivery models or contracting arrangements been used or tested for road infrastructure (Pakkala et al. 2007). Prior to the recent reforms in the road sector around the world, most public authorities followed the so-called traditional procurement model. Operation and maintenance

[4]Such innovative contracting practices are in fact being implemented not only in the road sector, but also in other infrastructure sectors, such as rail, public transport and ports.

tasks were realized mainly by road authority in-house personnel and infrastructure projects were financed directly, with public funds. Outsourcing took place on an ad-hoc basis.

Projects were normally divided into small tasks or work packages, for which private companies were hired. The road authority acted as the main contractor. Given the limited scale of the tasks assigned to contractors, contracts were prescriptive. Ex-post monitoring was done with a focus on the contractors' effort and on checking technical requirements. Price was the overruling selection criterion. Contractual relationships were valid for a relatively short period of time, normally the time needed to complete the particular task. And payments were made on the basis of unit costs. This system was designed under the principle that all operational risks and the entire responsibility towards users were to be fully and directly borne by the public authority.

Innovative practices have caused a shift in governance from a public bureau to a market-like arrangement. As explained above, in the old situation the public road authority did outsource but did so by tendering work orders. Contracts were signed directly with each contractor. The road authority had its own staff looking after the management and coordination of all project activities. Private parties only acted as a "hired hand" in the public sector (Salminen and Viinamäki 2001). In the new situation, the road agency signs a single contract for an entire project or a service agreement for a particular network for a particular time-span. Subcontracting of specialized works or particular work orders still occurs in the new system, but now under the responsibility and supervision of the main contractor. As government agencies advance in the use of these innovative procurement practices, their role becomes more that of a regulator and quality monitor, while the role of private contractors becomes more that of a service provider.

1.1.3 Expectations and challenges

Transportation agencies worldwide have discovered that traditional highway contract administration procedures and project delivery methods do not meet their current demands. Some of the problems being faced by them are: insufficient funds to meet satisfactory levels of all roads (Miller 2000, Cox et al. 2002, Pakkala 2002), little innovation (Manley and McFallan 2003), few value-added services for the client and a general lack of integration between the phases of the road life cycle. In response they have started to experiment with innovative project delivery methods.

Accordingly, independent of the market to which they are applied -either to the delivery of new capital projects or to maintenance or operation of existing assets-, innovative contracting methods aim at better quality or longer life cycles, cost-savings for the public client, transfer of risks to the organization best able to manage them, integrating as many processes as possible and completing projects faster than the traditional method.

Also, in the context of downsizing of government bodies and financial deficits,

an additional motivation for road authorities seem to be being able to operate and manage the existing road network with fewer capital and human resources. The lack of substantial funding has almost become their main challenge (Pakkala et al. 2007). Nevertheless, for the purpose of this study, this is not considered a priori the most important one.

To summarize, expectations are high: more contract flexibility[5] in the road sector, more innovation, higher performance and consequently lower costs, while keeping up service levels on public values, such as mobility, safety and the environment. But how successful have road authorities been in implementing such innovative arrangements in practice? And how can the positive results expected in fact be achieved? Are there also possible tensions between the aspects of contract flexibility and those regarding public values?

The policies implemented to increase contract flexibility and additional decision rights to contractors may actually increase the problem of information asymmetry between authority and contractors, because contractors probably hold more private information, which is not available to the authority. This informational advantage gives contractors more opportunities or room to act opportunistically and eventually in detriment of the network condition, threatening the fulfilment of public values (e.g. availability, accessibility, safety and affordability).

Therefore, as government agencies advance in the use of these innovative procurement practices -in the midst of much uncertainty and many knowledge gaps- and their role becomes more that of a regulator and quality monitor, it becomes more urgent to research the possible complementarities and tensions between the (technical) aspects of flexibility and those regarding public values, as well as the effects of these practices in the short and the long term, given the increasing freedom and decision power being granted to private contractors.

1.2 Research question and objectives

As explained above, innovative forms of contracting are expected to yield more flexibility in the road sector, more innovation, higher performance and consequently lower costs, while keeping up service levels on public values such as mobility, safety and the environment. Nevertheless, they may also result in wider room for opportunistic behaviour of contractors, which, if used, could actually pose a threat to the safeguarding of public values.

Therefore, the most challenging problem being faced over the last decades by national road infrastructure administrators as well as many other administrators of network bound infrastructures can be formulated as a trade-off: *How to achieve the*

[5] It is important to clarify that the term flexibility is used in this project to refer to contract flexibility, the space and design freedom that is given to contractors, and therefore does not refer to the resulting flexibility of the road infrastructure itself.

positive results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (on the part of contractors) and its (negative) effects at the minimum possible?

The present study aims to answer this question by investigating whether and how different countries and their national road administration authorities have found solutions to this issue and to draw lessons for road authorities around the world. Results expected from the research are:

- an overview of lessons each of the countries can draw on their own position and on how others perform;
- a dynamic comparative framework that could serve as a tool for countries to evaluate if elements from practices elsewhere can be incorporated in their own regulatory regimes, contractual arrangements and practices at home.;
- a generic tool or model that allows policy makers from different countries to experiment with different contract settings and incentives and to build from there the understanding needed to set the right incentives in their contracts, all within their own national institutional context.

In order to answer this normative question, besides the development of a (conceptual) research framework (presented in Chapter 2), a series of research techniques and methodologies was applied not only during the data collection phases but also to analyse the evidence gathered and draw conclusions.

A number of aspects play a role in finding a solution for the trade-off being faced by road administrators and therefore in answering this normative question. Achieving the expected results from innovative contracting practices requires that firstly, a road authority must succeed in their implementation (reviewed in Chapters 4 and 5); and secondly, the authority must ensure that these new contracts contain proper incentives that deal with the risk of opportunistic behaviour (treated in Chapters 4 and 6).

To be more precise, the successful implementation of new practices involves aspects like reform implementation processes (Chapters 4 and 5); combined use of different practices or innovative elements in a single contract (Chapter 4), in order to exploit all the existing synergies between the different practices (Chapter 3); and the creation of a competitive market. Likewise, the design of a proper approach to mitigate the negative effects of opportunistic behaviour, involves understanding of aspects such as enforcement mechanisms or compliance procedures (Chapter 4), as well as their viability given their implementation cost and the specific institutional environment in which they are going to function (Chapters 4 and 5).

Furthermore, in order to draw cross-national lessons, national experiences covering all of these different policy aspects need to be compared against the improvements achieved thanks to the implementation of new practices (Chapter 4). However, consensus has not yet been arrived at about the savings these practices have brought. This is mainly due to the lack of historical information about total life cycle costs

of assets. The available data on cost savings is relatively recent and does not allow for the drawing of a sustained trend or patter in time, which leaves questions about medium and long-term effects of these practices unanswered. In order to overcome this difficulty, the comparative field research has been complemented with a gaming-simulation component that enables the experimental study of medium and long-term effects on the performance of the system, such as network condition and market development (presented in Chapter 6).

Last but not least, the design of enforcement mechanisms to mitigate the negative effects of opportunistic behaviour also requires awareness of which concrete forms this behaviour may take within this new type of contractual relationship as well as an estimation of the implications of the consequences for the performance of the road system (Chapter 6). Evidence from research components, field research and gaming-simulation, will contribute to the understanding of these two issues.

Both comparative study and gaming-simulation are presented in further detail in Chapter 2. The countries selected for the realization of the comparative study are Finland, Spain and the Netherlands.

1.3 Essential elements and major differences with previous studies

The key elements of the research proposed are described below. These same key elements are central to the extensive differences between this study and related works in other domains.

- A dynamic and systematic comparative analysis that bridges both a space and a time dimension and recognizes the importance of path-dependency versus the static snapshot shown by most benchmark studies. Most benchmark studies in contracting practices are an inventory of best practices without properly drafting the institutional context and the drivers behind those practices, which the present author argues makes a considerable difference. Previous cross-national studies (Cox et al. 2002, Pakkala 2002, AECOM Consult 2005, Pakkala et al. 2007) in the subject do acknowledge the importance of institutional aspects and even suggest that further research in this area is needed. Nevertheless, none of them includes these factors in their research and/or aim to study systematically how they influence the shape these common contracting policies take in practice.

- The whole evolutionary path that has led to present contracting practices in the different countries studied is analysed systematically for three countries. The analysis maps the entire reform path, starting with the initial situation, exploring the sector structural reforms applied, moving on to the implementation of innovative contracting practices and even further to the anticipation of the effect of future practices. In addition, it maps the different stakeholders and

their positions before and after all these changes. This combination of a dynamic (evolutionary) perspective covering both sector reform and innovative contracting practices -where most studies cover only one of these aspects- and a cross-national perspective is new. Road sector literature so far only offers cross-national comparative studies either on the use of innovative contracting practices (Bousquet 2001, Cox et al. 2002, Pakkala 2002, AECOM Consult 2005, Pakkala et al. 2007), or on the conceptualization of the reform and restructuring of road authorities (Talvitie 1996, Dunlop 1999, Heggie 1999, Talvitie 1999), whereas studies establishing or examining the link between both are rare.

- The dynamic and comparative conceptual framework developed not only combines different theoretical bodies, but also a number of perspectives and methodologies needed to deal with these two levels of analysis: (a) road reform, which is national and described in terms of new governance arrangements and path dependent mechanisms; and (b) contracting practices, understood as the whole mix of practices in a national procurement strategy and zooming into incentives built into specific contracts. With the application of these two perspectives, the research contributes towards the development of a tool for cross-national analysis and lesson-drawing.

- The application of experimental techniques to research on the topic of opportunistic behaviour and its role of tendering and contracting. The issue of opportunistic behaviour has been widely discussed by many authors in the past and it has recently been described for the new setting of liberalized infrastructures -see the work of Heuvelhof et al. (2009) on strategic behaviour in infrastructure-based sectors. Nevertheless, the application of gaming-simulation or experimental techniques that allow the further classification and quantification of such behaviour, is relatively new.

1.4 Reader's guide

The present chapter introduces the motivation and background for this research. Chapter 2 presents the research design developed along with the conceptual framework and research methods adopted. It describes in further detail the two main elements of the research strategy, the cross-national comparative study of contracting practices and the gaming-simulation tool. In addition, it reviews the theoretical basis of the dynamic comparative framework developed.

Chapter 3 is concerned with the conceptualization of the Road Procurement System. First, an overview of most relevant issues in the specific area of public procurement of road infrastructure is presented. Second, in order to arrive at an accurate problem diagnosis, a formal analysis of innovative contracts in terms of agency theory and engineering design theory is realized. Third, an illustration is presented of the many

trade-offs and decisions that are nowadays realized by public infrastructure operators, and which may be transferred to private contractors in the future if innovative contracting practices become the norm.

Chapter 4 presents the empirical results from the comparative study realized through field research in Finland, the Netherlands and Spain. This includes a description of each of the national procurement models in place and their respective developmental paths, the main challenges ahead for each of them and a number of lessons learned. Empirical findings pose new questions and demand further analysis of two main issues. Firstly, the transferability of lessons from one country to another. Secondly, the estimation of the consequences of opportunistic contractors' behaviour if innovative contracting arrangements are to be applied full scale and to new sectors, such as periodic road maintenance. These two issues are explored in Chapters 5 and 6.

Chapter 5 investigates the influence that different institutional starting positions (e.g. external factors, initial conditions and historical and cultural circumstances) have on the developmental paths and on the outcomes of the reform in each of the three countries. As a consequence of these differences, the reform process of liberalization, privatization, private financing of projects and growing design freedom for contractors puts very different types of strains on these countries. The steps taken to "push through the reform", as policy-makers in each of the countries defined it, also diverged.

Chapter 6 presents the tool developed to investigate medium and long-term effects of innovative contracting practices, and the impact of different incentive schemes on promoting cooperative or defecting contractors' behaviour. It explains how the gaming-simulation developed, Road Roles, can contribute to our understanding of the consequences of new contracting practices, how the game was set up, and what the results were in the 14 different runs that were held in the Netherlands, Finland and Spain. The three most characteristic and colourful game-runs have been highlighted and described and discussed in more detail.

Finally, Chapter 7 elaborates on the implications of the research findings for procurement policy. It explores in greater detail some of the dilemmas confronting road authorities -and other infrastructure administrators experimenting with innovative contracting- in the future if innovative contracting is to be applied on a larger scale. To finalize, it provides recommendations for future research.

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Chapter 2

Research framework

Parts of this chapter have already been published in: Altamirano (2006).

2.1 Introduction

As government agencies advance in the use of innovative procurement and contracting practices and their role become more that of a regulator and quality monitor, than a direct operator of the road network; the more urgent is to research on the possible effects of these practices in the short and the long term given the increasing freedom and decision power granted to private contractors.

As it has been presented in Chapter 1, the problem being faced by national road infrastructure systems and by many other network bound infrastructures in the last decades can be pictured as an important trade-off; how to achieve the results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (of contractors) and the (negative) effects of it at the minimum possible?

This study aims at supporting national road authorities around the world in providing an answer to this question. This chapter presents the research design developed along with the conceptual framework and research methods adopted in order to give answer to the research question.

2.2 Research design

The first aim of the research is to draw lessons from international practices in contracting and administration of roads. Therefore the research object is the national system of road administration of different countries with a focus on their contracting practices.

2.2.1 Type of research: lesson-drawing and problemistic search

Consequently, the study proposed follows in great measure the guidelines established by Rose on the so called "Lesson-drawing in public policy" and it could be considered rather a problemistic search, practice driven research (evaluation type) than a pure theoretical one.

Cyert and March (1963/1992) have defined problemistic search as follows:

> Problemistic search can be distinguished from both random curiosity and the search for understanding. It is distinguished from the former because it has a goal, and from the latter because it is interested in understanding only insofar as such understanding contributes to control. Problemistic search is engineering[1] rather than pure science (Cyert and March 1963/1992, 121).

Lesson-drawing research starts with the definition of a problem; a common problem found in at least two different societies in the same policy area. Lesson-drawing is practical and theoretical. It is practical because it is concerned with making policy prescriptions that can be put into effect. Lessons are not learning in order to pass examinations; they are tools for action (Rose 1993). But it also has a theoretical element. Concepts are needed to generalize from experience in two different places and to formulate hypotheses about whether a policy can effectively transfer from one place to another (Rose 1991a;b).

Lesson-drawing therefore involves a search across space and across time. The analysis required to draw a lesson needs to bridge both dimensions, time and space. As what policymakers search are lessons that will change what they do and how they perform in the future, the time dimension is absolutely necessary.

In order to engage in lesson-drawing from experience, there are two preconditions; first, easy to access information about what other governments are doing, and second, different responses to common problems. As it will be explained later in greater detail, two choices have been made in terms of research strategy to fulfil these requirements; a choice for field versus desk research and a choice for pioneering countries within different families of nations.

An essential element of this type of research is to understand under what circumstances and to what extent practices or programs effective in country or city A or B will work in country or city C. The critical task in lesson drawing is to identify the contingencies that affect whether a program can be transferred from one place or time to another (Rose 1993, 118). Again, aiming at such understanding necessarily requires positioning the actions of the example and of the receiver country in both, time and space. This task has a clear functional focus; which means that although lesson-drawing often cuts across territorial borders, it remains within the boundaries

[1] Within this research, engineering is interpreted as design oriented social science.

of a given policy community, defined as the group of officials dealing with the same problem (Rose 1993). In the context of this research project, this policy community are road authorities in charge of the national system of highways.

Other main requirements for lesson-drawing -besides concepts, functional focus and so forth- is familiarity with the logic of cause-and-effect models; since a lesson is not a disorganized or loosely coupled set of ideas about what to do. A systematic study of the system being researched and the mechanisms at work will contribute not only to a more accurate diagnosis of the common problem being faced by different authorities but will also lead to easier application of the lessons draw from the cross-national comparison. System analysis techniques will be applied in Chapter 3 in order to illustrate this cause-and-effect model of the problematic been researched.

Important notions and assumptions of Rose (1993) lesson-drawing theory that apply to our view of the problem are:

First, a multiplicity of factors influence the outcome of a lesson-drawing process, or determine the feasibility and probability of practices from place A been applied in place B. The most important factors are (a) power, a primary condition for the implementation of a new policy in government, (b) knowledge, a source of influencing those in power, (c) resources, the second precondition for applying a lesson and (d) the political values of the policymakers in charge; "failure to take into account the values of the dominant coalition in government will leave a lesson in limbo; it can be applicable but, if politically unacceptable, it will not be applied" (Rose 1993, 15).

Second, the notion of institutions as necessary means. The hypothesis (hypothesis 2) is that the "more substitutable the institutions of program delivery, the more fungible a program" (Rose 1993, 124). Rose states that:

> Institutions represent clusters of political interests and values and may thus mobilize opposition to drawing a lesson (implementing a change or reform) inconsistent with their established interests. Strictly speaking, it is not the institution's form but its political clout that constitutes an obstacle to lesson-drawing. (Rose 1993, 124)

By adopting this notion, the interests and the power of different stakeholders become more relevant than when institutions are considered only at an abstract level.

Third, the notion of resources as constraints. The hypothesis (hypothesis 3) is that "the greater the equivalence of resources between governments, the more fungible a program is" (Rose 1993, 127). Laws, public employees, and money are three resources necessary to create public programs (Rose 1985). Difference in legal philosophy between Roman law, which predominates in Europe and Latin America, and the English common-law tradition, found in many countries of the British Commonwealth and in the Unites States (Ehrmann 1976) would imply that it would be easier to transfer programs between Roman law countries, where programs are described in relatively

abstract terms, than between common-law countries, where historical precedent is more important.

Lesson-drawing is both a normative and a practical activity. It is normative insofar as a prescription that a program in effect elsewhere should be applied here is a statement about what ought to be done. But it is practical too, for it is concerned with whether or not the prescription can be put into effect.

Differences between the study realized and the prescribed steps in lesson-drawing as proposed by Rose are twofold. First, the analysis does not follow (rigorously) the last three steps proposed by Rose (2005) (turn the model into a lesson fitting your own national context, decide whether the lesson should be adopted and decide whether the lesson can be applied) and go all the way to design a complete new program for a receiver country, but instead a choice has been made to develop a gaming-simulation tool that facilitates learning and lesson-drawing about the problem for different problem owners of diverse national backgrounds.

Second, through this choice for a tool, the findings of the research overcome the main weakness of lesson-drawing as depicted by De Jong (2009) in his article "Rose's 10 steps". De Jong main criticism is that the generic policy models proposed by Rose should be devoid of context, such as leadership style, cultural and historical background, after which it can be recontextualized as a "lesson" for its new environment. This problem is avoided by allowing the players of the gaming-simulation tool to bring into it their own institutional and cultural background.

2.2.2 Outline of research design

As explained in Chapter 1, main results expected from the research are an overview of lessons each of the countries can draw on their own position and on how the other performs and a generic tool or model that allows policy makers from different countries to experiment with different contract settings and incentives and build from there the necessary understanding to set the right incentives in their contracts, all within their own national institutional context.

Accordingly, the research has been designed as consisting of two main elements, a cross-national comparative study of contracting practices and a gaming-simulation tool (see Figure 2.1). The choice for case study methodology and gaming-simulation is justified in section 2.5.

The first element of the research is a cross-national comparative study designed as a multiple case study research with embedded units of analysis. The main unit of analysis is the national procurement strategy with all its components. The embedded units are projects, preferably Public Private Partnerships (PPP) projects that embody such innovative contracting practices. Case studies have been realized in Finland, Spain and the Netherlands.

The historical recount of the national reform and procurement models realized through case study research is complemented with a gaming-simulation tool, Road

Roles in order to explore long-term effects of future scenarios in innovative contracting, especially for the case of periodic road maintenance where fundamental reforms are expected.

In order to answer the normative research question, a series of sub-questions was formulated for each of the research components, the cross-national comparative study and the gaming-simulation exercise. These questions are presented in the following two subsections. In addition a series of research techniques and methodologies was applied not only during the data collection phase but in order to analyse the evidence gathered and draw conclusions. These are presented later in this chapter, in section 2.5.

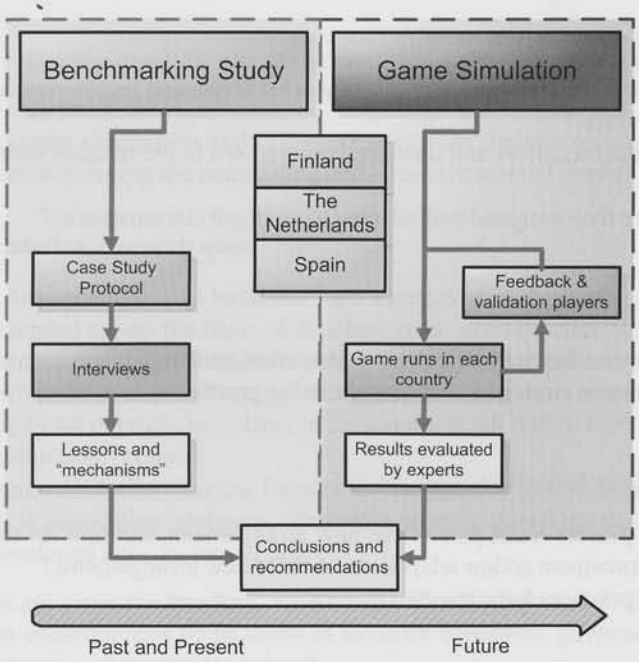

Figure 2.1: *Research design*

Research questions of the cross-national comparative study

The main objective of the cross-national comparative study is to draw lessons from the group of pioneering countries selected on how they have solved the dilemma posed by the use of innovative contracting practices, as depicted by the research question. In order to draw such lessons the following questions were formulated for each individual case study. As it will be explained later (see section 2.5) these questions have been

operationalized in the so-called case study protocol designed.

What are the contracting policies in the different countries?

Procurement strategies

- What are the procurement strategies followed by these countries?
- What are the (new) contracting policies regarding design, construction, maintenance and operation of transport infrastructure?

Design freedom and enforcement mechanisms

- What performance indicators (and at what level) and requirements are listed in the contracts?
- And what incentives and disincentives are used in the relation with the contractors?
- How are they enforced and adapted to changed circumstances?

Drivers of change

- What were the drivers for the formulation and implementation of these new procurement strategies and/or contracting practices?

Players and their behaviour

- Which players make part of the new arrangements and how do they deal with the enforcement and/or adaptation of these new arrangements?
- Which practices have resulted thereof?

Service level

- What results have these new arrangements delivered?

Public Values

- What public values need to be safeguarded?
- What impact do these new arrangements have on the achievement of these public values?
- How did the institutional structures and other context dependent variables influence the results of these practices?

Institutional structures

- What are the regulatory structures regarding the use of performance requirements in design, construction, maintenance and operation in each of these countries?
- What features of the national institutional structures and culture proved decisive for the success or failure of the designed policies?

Context

- Which external factors also played a determinant role in the resulting practices?

Further, the following question was asked concerning the pattern of findings across cases studies:

What are the main similarities and differences between the contracting practices of these countries concerning the contracting and administration of roads?

Gaming-simulation research questions

To point out how concretely to build the right incentives in these new contracts, the study was extended to -on the basis of this first cross-national comparison- also develop a generic tool or model that allows policy makers of different countries to experiment with different contract settings and incentives and build from there the necessary understanding to set the right incentives in the contracts, all within their own national (legal and institutional) context.

The gaming-simulation exercise focuses on the issue of how to limit opportunistic behaviour in innovative contracts. Therefore specific questions that the gaming-simulation developed aims to answer are:

If contractors are given the freedom, what trade-offs will they make? And what will the long-term consequences be in terms of network condition, government finances and competitiveness of the private sector?

2.2.3 Research scope

As shown in Figure 2.2, the whole research project could be located in the area between system and subsystem level. At the system level one finds the national grid and therefore this is the proper level to study the overall and national procurement strategy of the road agency, the trends in general contracting practices and the impact of these strategies in the fulfilment of public values. Nevertheless in order to study more specific and operational issues as the use of Key Performance Indicators (KPIs) and the design space given to contractors, it is necessary to go one level down where specific new road projects could be studied. Thus, though the national procurement strategy

seems the convenient research unit for some aspects, concrete projects as embedded research units also need to be considered.

The gaming-simulation exercise is also located at the project or contract level, but differs from the comparative study in its orientation towards a future versus history-oriented perspective, as it aims to research the impact of future contracting practices in the medium and long-term.

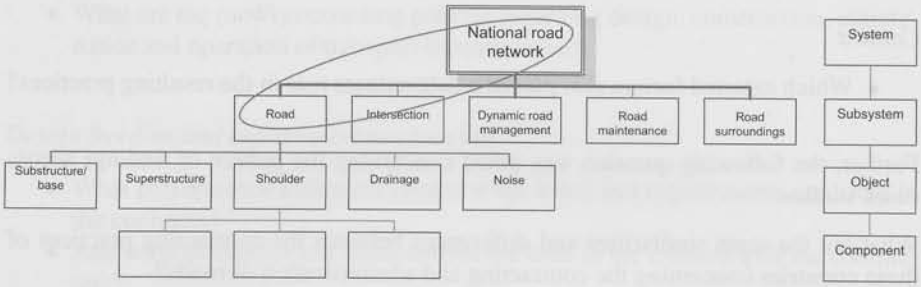

Figure 2.2: *System levels*

2.2.4 Key concepts and their contribution to the research

The theoretical basis of this research project combines economics (agency theory, new institutional economics, old institutional economics and other evolutionary theories) with engineering design theory. In addition the methodologies that supported the development of a case study protocol and a generic tool (gaming-simulation) as well as the analysis of the empirical data gathered are system analysis (system dynamics), stakeholder analysis, case study research and gaming-simulation.

The most important notions on the basis of which the comparative study has been realized are presented in Table 2.1. The table presents the correspondence between notions and theories from which they have been adopted for each of the levels or layers of the system been studied. The contribution of each of the different theories will be presented in Section 2.4 (literature review) where the main elements of the conceptual framework -resulting from this literature review- are introduced. A review of the notions adopted from the practitioners' literature will be presented in Chapter 3.

The location of these concepts within the different system levels is depicted in Figure 2.3. The spectrum or variety of (single) contracts between the road authority and particular contractors reflect a more general contracting practice of the road agency. At the same time the contracting practices of the agency make part and are supposed to be coherent with the overall procurement strategy of the road sector, which is in return

influenced by the national political discussion or the public administration tradition as a whole.
In the same manner, the performance indicators -at the technical or functional level- that are considered in the contracts or in other evaluation mechanisms between the authority and the contractor are expected to contribute to a specified service level agreed between road authorities and the corresponding transport or public works ministries in charge. At last the realization of such agreements set the basis for the fulfilment and safeguarding of public values, for which the overall national government and not only the transport related authorities are held responsible.

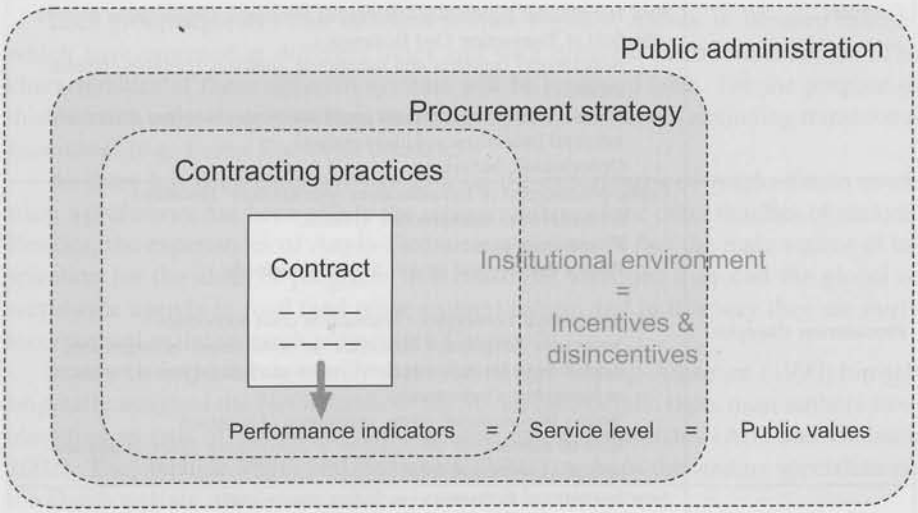

Figure 2.3: *System layers and location of concepts*

2.3 Countries selected for comparative study

The countries selected for the realization of the comparative study are Finland, Spain and the Netherlands. The choice for these cases has been based in two main criteria.

The first decisive factor has been to ensure considerable variety of institutional contexts. Given that one particular concern of our research is to find out whether the institutional environment matters in the way practices are implemented and whether and how contractors make use of the newly created room for opportunistic behaviour dependent on the set of formal and informal institutions; it is essential to ensure a variety in the cases such that they represent different legal and cultural families of nations.

Table 2.1: *Conceptual framework: theories and notions adopted*

System layer or element	Theory and notions adopted
Contracts	Agency theory (formal analysis of contracts) assuming self-enforcing contracts - Conflict of interests (incentive compatibility constraint) - Uncertainty and information asymmetry (private information) - Incentives in contract design New Institutional Economics (also called Economic Organization theory) - the field of Transaction Cost Economics - Neoclassical contracts and incomplete contracts (credible commitments) - Enforcement procedures and coordination mechanisms: formal and informal (incentives and disincentives) - Opportunistic behaviour
Procurement strategies	Public procurement of Infrastructures (practitioners' literature) - Elements in an infrastructure system - Procurement process - Project delivery and project financing methods New Institutional Economics - Transaction costs economics - Variety in governance structures or institutional arrangements - hybrids (neoclassical contracts) versus markets (classical contracts) or hierarchies (forbearance) - Variety in contractual forms -typologies of contracts - Role of institutional environment in determining adoption and success of a contractual form
Public administration and provision of infrastructures (including political arena) in different institutional environments	New Institutional Economics (including macro-level) - Different layers of institutions and - Pace of change - Institutional environments: different national formal and informal settings - Social capital (trust) New Public Management - Public sector reform: liberalization and privatization processes Evolutionary economics and Old Institutional Economics - Multiple equilibria - Path dependency - Increasing returns and self-reinforcing processes
Performance indicators → service level → public values	Engineering Design - Design space or design freedom - Design levels Performance contracting (practitioners' literature) - Hierarchy of performance indicators

Adopting the classification of Esping-Andersen (1990) four groups of families of nations have been considered. First, the liberal Anglo-Saxon group which includes the UK[2] and Ireland and outside Europe other western developed countries like USA, Canada, Australia and New Zealand. Secondly, the conservative group of Continental European countries which includes Germany, Austria, the Netherlands and Belgium. Thirdly, the social democratic group of Scandinavian countries, which includes Norway, Sweden, Finland and Denmark. And finally, the Southern European group of countries (Esping-Andersen 1990, Baldwin-Edwards and Gough 1991, Castles 1993, Ferrera 1996) like Spain, France[3], Greece, Italy and Portugal (Bolderson and Gains 1994).

Each group represent four different welfare regimes, mainly in Western Europe, which have emerged at different times and with different institutional forms. The characteristics of these different systems will be reviewed later. For the purpose of this research only western welfare states have been considered, excluding transitional economies (e.g. Easter European countries).

As there has been extensive research on the experiences of Anglo-Saxon countries, a preference has been give to the representatives of the other families of nations. Besides, the experiences of Anglo-Saxon countries are in fact the main source of inspiration for the ideas or programs that constitute what one may call the global or worldwide agenda in road (and other sectors) reform and in this way they are fairly incorporated in the research project (see Chapter 5).

It may be important to clarify that even though Esping-Andersen (1990) himself originally assigned the Netherlands to the Social-Democratic type, most authors have classified as part of the conservative continental welfare states (Arts and Gelissen 2002). They include Visser and Hemerijck (1997), perhaps the leading specialists on the Dutch welfare state.

The second decisive factor has been the perceived pioneering position of the country selected within its group; pioneers or good examples is often where policy makers search when the objective is to draw a lesson. Within the groups of families of nations selected -Scandinavian, Continental Europe and Southern European- Finland, the Netherlands, and Spain accordingly seemed suitable candidates for this position as by 2005 when the study started. Important differences between these countries, according to group of nations to which they belong and their administrative styles follow.

[2]The UK is sometimes considered a mix of liberal and social democratic, with the former predominating in the last two decades. Source: Baldwin-Edwards and Gough (1991)

[3]Some authors like Bolderson and Gains (1994) have considered France as pertaining to the conservative group, but others like Cox and D'Erman (2006) include France as part of the Southern European group.

2.3.1 Differences in public administration

The countries selected also represent a rich blend of administrative styles. Finland is a republic and unitary state of parliamentary democracy with elections on two levels, parliamentary and local. It has a president and a prime minister. The president is elected by popular vote for a six-year term. The president nominates the prime minister and a deputy prime minister after the parliamentary elections and the parliament must approve these nominations. The parliament is unicameral with 200 seats and elections every four years. The state organization is divided into six administrative provinces. These have little significance or power. In fact the provincial authority is part of the central government's executive branch and is not directly elected; therefore they are purely administrative units.

The Netherlands is a parliamentary democratic constitutional monarchy. The prime minister is the head of government and active executive authority; who often is the leader of the majority party or coalition in the lower house of parliament (second chamber). The Dutch parliament consists of a first chamber, comprised of 75 members elected by provincial legislators to terms up to six years; and a second chamber made up of 150 members popularly elected under a system of proportional representation to terms up to four years.

The state is divided in twelve administrative regions called provinces. Each provincial authority is made up of a provincial council, a provincial executive, and the Queen's Commissioner. The members of the provincial council are elected for four years by voters resident in the province. The provincial council then appoints some of its number to serve a four-year term as the provincial executive. The Queen's Commissioner is appointed by the government for six years, after which s/he may be reappointed. S/he presides over both the provincial council and the provincial executive.

Spain is a parliamentary representative democratic constitutional monarchy, whereby the monarch is the head of state and the president of the government is the head of government. National legislative power is constituted by two chambers of parliament (Cortes Generales) both elected on a provincial basis; the Congress of Deputies comprised of 350 members and the Senate made up of 264 members (208 elected by popular vote and 56 appointed by the regional legislatures). The Congress and Senate serve concurrent terms that run for a maximum of four years. With few exceptions, every law is approved with the votes of Congress. The Senate can make changes or refuse laws but the Congress can ignore these amendments.

Spain has become one of the most decentralized states in Europe. Spain is nowadays what is called a "state of autonomies" (Colomer 1998), formally unitary but, in fact, functioning almost as a Federation of Autonomous Communities, each one with different powers and laws. Differences are explained by the fact that decentralization -which started in 1978- has not derived from an explicit constitutional mandate, but rather from party strategies, competition, and bargaining. In other words, power has

been transferred from the centre to the periphery in an uneven way, with some autonomous communities -especially those governed by nationalist parties like Basque Country and Catalonia- seeking or inquiring more actively for a federalist kind of relationship with the central government. All seventeen autonomous communities are ruled by a government elected by a unicameral legislature.

As a consequence of this decentralization process that started in 1978, the Spanish State is currently "organized" in three levels: central institutions (e.g. government and parliament), regional institutions, called "Autonomous Communities" (also with governments, parliaments and other institutions with regional jurisdiction) and local administrations.

Since the Spanish model is characterized by a high level decentralization, a slightly different approach was followed in the field research conducted in Spain versus Finland and the Netherlands. The study of the Spanish case included an extra unit of analysis, the autonomous community of the Basque Country, more specifically the Foral Deputation of San Sebastián.

2.3.2 Differences between welfare regimes

Esping-Andersen (1990) argues that the provision of social policy and the interaction between markets, states and families follows a certain logic, which differs across the four clusters of welfare states. He empirically distinguished these clusters by their respective degrees of "decommodification"[4] and "stratification"[5].

The Liberal Anglo-Saxon nations are characterized by the combination of low decommodification and strong individualistic self-reliance which leads to the stratification of society. The liberal type of welfare capitalism embodies individualism and the primacy of the market. The working of the market is promoted by the state, actively by subsidizing private welfare schemes and passively by keeping social benefits limited and aiming to support mainly low-income groups demonstrably in need. Accordingly there is little redistribution of incomes within this system and an active encouragement of the use of non-stated alternatives such as private forms of social protection. All in all the liberal principle about freedom to compete in the market incorporates elements of insecurity that may result in poverty. Nevertheless, from a liberal perspective this "is not the fault of the system, but solely a consequence of an individual's lack of foresight and thrift" (Esping-Andersen 1990, 42).

[4] As markets have become universal and hegemonic, the welfare of individuals comes to depend entirely on the cash nexus, which means that people have become commodified.

Decommodification is understood as the degree to which "individuals or families can uphold a socially acceptable standard or living independently of market participation" (Esping-Andersen 1990, 70-71). The presence of social assistance may not necessarily result in significant decommodification. If benefits are low and associated with social stigma, the relief system will oblige all but the most desperate to participate in the market.

[5] Stratification refers to the type of social structure which welfare programs promote; they can either reinforce the established social stratification or promote a change through redistribute benefits.

Continental European countries have been group together as conservative or corporatist. This welfare state is typified by a moderate level of decommodification and seeks preserve status differentials by providing transfers closely linked to previous earnings. This system finds its origins in the twin historical legacy of Catholic social policy, on the one side, and corporatism and étatism on the other side. Accordingly the conservative approach to social policy, welfare, and the decommodification of labour is based upon stratification along class lines and the preservation of a hierarchical or patriarchal structure.

Another important characteristic of the conservative regime type is the principle of subsidiarity: the state will only interfere when the family's capacity to service its members is exhausted (Esping-Andersen 1990, 27). The state aims at minimal intervention but -different than in liberal regimes- does not fail to intervene to protect those who are unable to succeed in the market place through no fault of their own.

In the third "social democratic" type the level of decommodification is high, and the social-democratic principle of stratification aims at achieving a system of generous universal and highly distributive benefits not dependent on any individual contributions. Accordingly this system fosters cross-class solidarity and equality. In order to finance such a high-level solidaristic welfare system, high levels of employment and taxation are required (Arts and Gelissen 2002).

A main characteristic of this regime is the notion of social citizenship or its universalist approach, which makes it differ significantly from the conservative regime and its principle of subsidiarity. The primary concern is not to wait until the family is unable to provide further, but "to pre-emptively socialize the costs of familyhood" (Esping-Andersen 1990, 26). It actually strives to remove reliance upon family groups as the first alternative to the market and in this way shares with liberalism its emphasis on individualism. Nevertheless, at this point stops their resemblance. In contrast to the liberal type this "model crowds out the market, and consequently, construct an essentially universal solidarity in favour of the welfare state" Esping-Andersen (1990, 28).

Finally there is the Southern European model, which resembles an underdeveloped version of the conservative regime but has some distinct characteristics that require a separate categorization. Castles distinguish Southern European welfare states from conservative ones based on their heavier reliance on the family and stronger historical ties to the church. Meanwhile Baldwin-Edwards (1997) mentions three other differences. First, the coverage of the population is low, with very low or no benefits for those who fall outside. Secondly, the differentiation of benefits is very high -far greater than would reflect occupational earnings differentials, with privileged groups obviously benefiting. Thirdly, a massive asymmetry of pensions expenditure alongside underdeveloped unemployment benefits and inadequate universalistic national health systems. An additional difference has been pointed out by Ferrera (1996); the management of the para-state funds is non-transparent and in certain cases heavily subsidized by taxation in clientelistic fashion.

2.4 Literature review

As explained before, lesson-drawing research requires concepts, which in fact have more importance than theories in this type of research, as they determine the questions one asks and therefore the answers one gets. Concepts provide common points of reference for grouping activities of agencies in different cities, states or countries (Rose 1991a).

Accordingly this section presents the findings of the first theoretical review realized in terms of a list of relevant concepts and assumptions adopted from different theories in order to answer the main research question. These concepts and assumptions have served as a guide for the development of the research strategy and case study protocols, and have contributed -together with the practitioners' literature (Chapter 3) to the list of criteria against which the different national cases have been compared. For a detailed recount of the links between these notions and research questions as well as criteria implemented for the study of national procurement models see Appendix A and B.

2.4.1 Key concepts in agency theory

Agency theory is considered one of the most formal parts of New Institutional Economics, because this theory rest upon standard neoclassical assumptions concerning self-interested rationality Rutherford (1994, 3). While the notions of asymmetric information and externalities are not themselves new to traditional neoclassical economics, agency theory and related models are based on the concept of positive transaction costs, which distinguishes these new institutional theories from neoclassical theory (Sykuta and Cook 2001). Even though the principal-agent relationship is one of the fields of study of NIE, it will be presented separately in this review, as it does not deal explicitly with institutions -in the wider sense- and their influence on contractual performance.

Agency theory seems to offer a great explicative and analytic potential for the formal study of innovative contracting because of two reasons. First, it allows to explicitly incorporate in the analysis conflicts of interest, incentive problems and mechanisms for controlling incentive problems (Lambert 2001). Second, it focuses on the role of information in "metering" inputs and outputs to deal with agency costs. The limitations of this theory for the (empirical) comparative study of contracting practices will be reviewed later.

In economics, the principal-agent problem treats the difficulties that arise under conditions of incomplete and asymmetric information when a principal hires an agent. The relationship between the public road administration or authority that tenders the project and private contractors could be then described in terms of agency theory as the relationship between principal (authority) and agent (contractor).

In other words, agency theory aims to answer the question "How to develop an

optimal design of an organization or how should a contract be designed to motivate the agent optimally to act in a way that serves the interests of the principal in the context of conflict of interest between principal and agent?" Within this main question, the most frequent notions covered are conflict of interests, information asymmetry and uncertainty, entering into agreements and concluding contracts and how contracts influence the behaviour of the participants.

Agency relationship

Jensen and Meckling (1976, 308) define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent. In the simplest agency model, the relationship is reduced to two people: the principal and the agent. The agent is the individual or economic agent who undertakes the action and the principal is that one whose welfare (utility) is affected by agent's actions.

In other words, the roles of the principal are to supply capital, to bear the risk, and to construct incentives, while the roles of the agent are to make decisions on the principal's behalf and sometimes also to bear the risk (Lambert 2001). If both parties are assumed to be utility maximizers there is good reason to believe that the agent will not always act in the best interests of the principal (Jensen and Meckling 1976).

It is important to frame the agency relationship in a time domain, so that it becomes clear in terms of information. When a time line that outlines the sequence of the events, is built, it becomes easier to keep track of who knows what and when. An example of such a time line is presented in Figure 2.4.

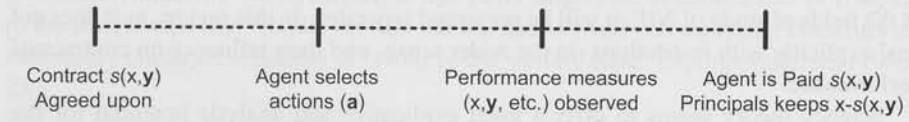

Figure 2.4: *Time line of the "plain vanilla" principal-agent model. Source: Lambert (2001, 6)*

As can be seen in Figure 2.4, the first step is the closing of a contract between principal and agent. Even though it is not shown in the figure, this step is the result of previous rounds of tendering, from which only one contractor is selected. Even before the tendering process starts, the principal selects a performance evaluation system which specifies the performance measures (or information signals) upon which the agent's compensation will be based and the form of the function that links the performance measures to the agent's compensation.

In the graphic, s denotes the compensation function and $\mathbf{y}$ denotes the performance measures to be used in the contract. In the second step the agent -based on this contract- selects a vector of actions, $\mathbf{a}$; which could include operating decisions,

financing decisions, or investment decisions. These decisions along with other exogenous factors (generally modelled as random variables) influence the realizations of the performance measures, as well as the "outcome" of the firm, which is denoted by x. Finally, after the performance measures are observed and analysed, the principal pays the agent according to the terms of the contract.

An important term in this process of a principal choosing an agent, is tendering. Competitive tendering in few words refers to the system of purchasing goods or services by inviting bids or "tenders" and choosing the supplier from among the bids received. Other things being equal, often the cheapest tender will be chosen or the one that offer the greater value for money. Tendering occurs when firms bid the right to run a services or gain a certain contract.

Competitive tendering may mean different things to different people. However the intention of a tender process is always the same: to obtain a like for like comparison for a clearly stated amount of work. As Sayers (1997, p. 22) notes, there are two key requirements for fair tendering:

- The client has to produce documents with exact specifications and quantities;
- The tenderers have to price the documents, without colluding with other tenderers.

Incentive compatibility constraint

An important constraint in the agency model is the incentive compatibility one, which stems from the assumption that both principal and agent are rational, self-interested individuals aiming at maximization of their utilities. This constraint influences the way the agent selects his actions and his level of effort. When this constraint is included in the model, it is expected that the agent will choose actions, not cooperatively, but selfishly.

The root of this constraint can be clearly seen in the utility functions of both, principal and agent, where it is assumed that higher levels of effort are more personally costly to the agent -also called "disutility effort".

Typical reasons for conflicts of interest referred by Lambert (2001) are: a) effort aversion of the agent, b) the agent can use or divert resources of the principal for his private consumption, c) different time horizons, mostly the agent being less concerned about the future than the principal and d) differential risk aversion on the part of the agent.

To sum up this constraint states that the action chosen will be the one that maximizes the agent's expected utility given the contract offered by the principal.

The principal-agent problem

Consequently, the principal's problem or so-called the agency problem is:

> The problem of inducing an "agent" to behave as if he were maximizing the "principal's" welfare. ... How to structure the contractual relation (including compensation incentives) between the principal and agent to provide appropriate incentives for the agent to make choices that will maximize the principal's welfare given that uncertainty and imperfect monitoring exist (Jensen and Meckling 1976, 309-310).

As becomes clear from this definition, the solution to this problem is rather complex, precisely because both principal and agent face uncertainty in different ways.

The principal-agent literature explains that, to reduce moral-hazard problems and minimize agency costs associated with these problems, contracts should follow a "carrots and sticks" format (Mirrlees 1997). As the above definition says, the principal must stimulate the agent to select the action that will maximize his expected utility. Thus, the principal must design a contract that balances incentives and risk sharing as well as rewards and punishments. Or in other words he must aim to reward the agent when the desired outcome is relatively more likely due to his actions and penalize him if the desired outcome is relatively less likely due to inappropriate actions by him (Kreps 1990).

Uncertainty and information asymmetry

As mentioned above, uncertainty is present in the agency relationship in various ways. The first kind of uncertainty makes reference to the economic term of "information asymmetry". Due to the fact that is the agent who undertakes the action, it is common that the actions of the agent are not observable for the principal and therefore the principal is uncertain about the action's undertaken by the agent and/or information held by the agent. Thus there is a state of asymmetric information because the agent possesses information that the principal does not. This information is also called "private information" and the economic advantage that the agent can win by using this "private information" in his own interest, is denominated "information rent".

The second kind of uncertainty concerns the outcomes of the agent's action. Both, principal and agent are uncertain about the causality between agent's action and the resulting outcomes. Uncertainty and information asymmetry pose additional constraints on the agency relationship that complicate the design of the contract. They create two types of problems: an adverse selection and a moral hazard problem (Padilla 2002).

Adverse selection

The problem of adverse-selection arises when the agent possesses information probably useful or relevant for the process of selecting his actions, which is not available to the principal. Therefore, it is not possible for the principal to judge if the agent has selected the most appropriate action or not, in the light of the information he possessed (Padilla 2002).

The moral hazard and incentives

A moral hazard problem arises when the actions of the agent are not observable to the principal because (a) monitoring agent's action is costly and (b) it is not possible for the principal to perfectly infer agent's actions by observing the outcome because these do not completely determine the outcome.

Consequently, the principal is confronted with two problems. First, given that the cost of monitoring the actions of the agent is generally too high or prohibitive, he cannot design contracts based on his observation of the agent's actions. Second, he also cannot base his compensation function or contract entirely on the outcome for two reasons (a) he is uncertain about the effect of the agent's effort or actions in the outcome and (b) because if he would anyway base his compensation function on the outcomes, the agent risk aversion would prevent him from signing in such a contract.

It is precisely this problem that makes it impossible and impracticable to design "complete contracts" that determine the compensation of the agent on either his actions or on the outcomes of his non-observable actions. This means that even when outcomes would be observable for the principal, he cannot achieve solely by means of a contract, that the agent bears the full consequences of his actions.

Therefore, the possibility to practice "discretionary behaviour" is open to the agent; this means that the agent can undertake actions that go against the interest of the principal:

> Moral hazard may be defined as actions of economic agents in maximizing their own utility to the detriment of others, in situations where they do not bear the full consequences or, equivalently, do not enjoy the full benefits of their actions due to uncertainty and incomplete or restricted contracts which prevent the assignment of full damages (benefits) to the agent responsible (Kotowitz 1987, 549).

This danger applies to some extent to all contracts that are written in a world of information asymmetry, uncertainty and risk.

Performance-based compensation

The principal-agent problem varies as the agency model becomes more and more complex. First, when a basic, single-action and single-period model is considered, the problem of the principal is to motivate the intensity of the agent's effort. Second, when multiple-action is assumed, the problem of the principal becomes more complex, because he has not only to motivate the total intensity of the agent's effort but also a good allocation of this effort. And finally, when a multiple-action and multiple-period model is considered, the principal's problem is also to motivate long-term investment decisions.

Performance measures, as the basis of carrot and sticks contract formats, have an important role reducing the magnitude of the agency problem. The key characteristic

of a performance measure is its "informativeness" (Lambert 2001) about the agent's effort, which is a function of its sensitivity to the agent's action and its noisiness. Given the increasing complexity of the principal's problem when multiple-action and multiple-period models are considered, the informativeness and congruency of the additional performance measures or indicators becomes more difficult and important to determine.

Stewardship versus valuation uses of information

An additional issue raised by agency theory is the difference between the uses of performance information for valuation or compensation purposes. Agency theory shows that, in general, the way information is aggregated for valuation purposes is not the same way this information would be aggregated for compensation purposes (Lambert 2001). That is, valuing the firm is not the same as evaluating the contribution of the manager.

> That is, suppose we write the outcome function as $x = a + e$; where a is the agent's action and e is a random variable that represents other factors that affect the outcome. From a valuation perspective, we care only about the sum of a and e; however, from a compensation perspective, we care about the individual components (Lambert 2001, 42).

In both single-action and multi-action models , when x is observable there is still a role for additional performance variables in the contract as long as they are incrementally informative about the agent's actions. These variables need not be incrementally informative about the outcome, just about the actions.

This division between valuation and compensation purposes could be of importance in the research and analysis of contracts, particularly for the study of performance indicators. Especially if the trend towards outcome-based compensations systems, assumes that valuation will be equal to compensation. Nevertheless, the general public seems to expect that government will remain responsible (towards citizens) for the overall outcome and contractors only for their "actions". Consequently, the transition period will probably require the use of two sets of performance indicators, one used for "policy" purposes and more oriented towards "valuation" of the whole system; and another set which is more congruent and gives more information about the actions of the contractors, and therefore meant for "compensation" purposes.

This is one of the big dilemmas of the inclusion of performance measurements in contracts: which level of indicators is applied and linked to compensation; outcome (valuation), output oriented or effort related indicators? A hierarchy of indicators in this spectrum for the specific case of roads will be presented in Chapter 3. Can contractors be held responsible for outcomes that do not just depend on their effort but also on a number of external factors? And does this mean that the role of government (normally responsible for outcomes) will radically change, transferring its main responsibilities to the private parties?

Agency costs

Agency costs are a type of transaction cost. They reflect the fact that without cost, it is unattainable for principals to ensure agents will act in their interest. Jensen and Meckling (1976) define agency costs as the sum of:

(1) The monitoring expenditures by the principal; like the costs of investigating different agents and selecting the right agent, gathering information to set performance standards and monitoring agents.

(2) The bonding expenditures by the agent. In some situations the principal will pay the agent to expend resources to guarantee that he will not take certain actions which would harm the principal or to ensure that the agent will make optimal decisions from the principal's viewpoint.

(3) The residual loss, which is the dollar equivalent to the reduction in welfare experienced by the principal whenever the actions that would promote the self-interest of the principal differ from those that, would promote the self-interest of the agent.

Agency costs have important policy implications for contract management, specifically related to information costs. Not only the process of managing a contract involved agency costs, but also the advantage of the contractor in terms of private information regarding performance means that the contractor may be able to impose high agency costs by withstanding the principal's effort to gain information. Therefore the more difficult it is for the principal to gain information on performance outcomes, the more likely those contracts will be framed instead in terms of contractor behaviour or contractor effort. The more uncertain the outcomes, the more the agent will have an incentive to resist the principal's information-gathering efforts so as to promote behavioural rather than outcome performance standards.

Privatization as a solution to the principal-agent problem

The privatization of infrastructures and other government services considers not only the relative production costs of these services if carried by the public sector versus the private sector, but also the issue of agency or transaction costs. The decision whether to privatize or not often focuses on finding the optimum point of privatization where the marginal total cost (agency costs plus production costs) equals their marginal benefit. This decision gains complexity as there are different forms of separation of ownership or sovereignty from control possible, which includes many forms of contracting out, which may also carry high agency costs (Sappington 1991). Options for outsourcing vary between the situations in which contractors may actually be in-house governmental agents, not representing privatization at all, to the so called contract state. The contract state is a reference to one model for solution of the principal-agent

problem, namely radical contracting-out of otherwise governmental services. Public administration in New Zealand is often taken as a model (Schick 1998) of such a contract state.

2.4.2 Strengths and limitations of agency theory

Agency theory offers a great potential to the formal analysis of innovative contracting and out-sourcing practices as it addresses information asymmetry and incentive incompatibility between contracting parties. An implicit statement in the analysis it proposes is the assumption that information asymmetry is costly to correct. These costs may include ex ante search costs, associated with adverse selection or hidden information problems, and/or ex post monitoring and enforcement costs, associated with moral hazard or hidden action problems (Sykuta and Cook 2001, 4).

Contracts could be seen as different forms for solving the universal problem for a principal of monitoring agents: '

> The problem of inducing an "agent" to behave as if he were maximizing the "principal's" welfare. ... How to structure the contractual relation (including compensation incentives) between the principal and agent to provide appropriate incentives for the agent to make choices that will maximize the principal's welfare given that uncertainty and imperfect monitoring exist (Jensen and Meckling 1976, 309-310).

All these notions and assumptions have proved relevant and helpful for a first analysis of the different trends in contractual arrangements in the road sector (see Chapter 3); However, there is an additional assumption that has proved to be problematic for the solely application of agency theory as theoretical framework for the empirical and comparative analysis of contracting practices and their results in the three different countries covered in our research.

Agency theory assumes that contracts must be "self-enforcing" which means that with their implementation dependent on built-in mechanisms and these contracts could be considered as closed systems. In this model, institutions do not matter. The need for institutions would actually signal contract failures, i.e., the necessity of using external constraints if contracts were badly designed (Ménard 2002, 241).

This view is not completely in line with the view of some renowned New Institutional Economists (Davis and North 1971, North 1991, Ménard and Shirley 2005) who depict contracts as "institutional arrangements". According to Ménard (2002) the criticism of these authors for this limited view are threefold. First, agency theory considers contracts as devices almost exclusively designed for solving incentive problems, therefore neglecting their central role as frameworks for organizing and coordinating transactions in all their dimensions. Second, it ignores differences in the modalities for transferring rights of use, which is what contracts are about. Third, it leaves aside the explanation of why there is a need for many different forms of enforcement. To

sum up, transaction costs economics (TCE) would offer a more suitable explanation of the diversity of contractual arrangements.

The explanation of this diversity and the origins of different contracting practices is an important element of the comparative research that has been carried out, therefore the need to enrich our theoretical framework by explicitly adding institutions and the notions proposed by theories as TCE and other fields of study of NIE, besides agency theory. Besides, as it will be reviewed later again the assumption of self-enforcing contracts, which aims at "complete contracts" or assume the possibility of comprehensive contracting[6], may only apply to classical contracts, according to contract law. Such contracts refer to transactions where low asset specificity and relatively stable conditions hold (Williamson 1979; 1991). Under such contracts the identity of the parties to the transaction is not relevant and in this way they correspond exactly with the "ideal" market transaction in economics (Williamson 1979).

Meanwhile the changes in procurement practices have meant a change from hierarchical organizations realizing a high proportion of works in-house, complemented in an ad-hoc way by markets where short-term prescriptive contracts ("classical contracts") were tendered; to full-scale outsourcing strategies characterized by longer-term, performance-based and even privately projects which are more of an hybrid type -between hierarchies and markets- of coordination mechanism.

2.4.3 Key concepts in New Institutional Economics

Mostly three groups of theories are listed under the heading of NIE: property right theory, principal - agent theory and transaction cost economics (Groenewegen and de Jong 2008). These theories have developed to provide a finer theoretical framework by which to analyse the structure of transactions and their governing institutions. They bring forward recommendations on how the rights and responsibilities that make part of the transaction are allocated depending on the transaction characteristics, the costs of monitoring and enforcement, the relationship of the trading parties, and their respective negotiating skills or bargaining position (which might be influenced by control rights over complementary assets) (Sykuta and Cook 2001).

All in all NIE provides a new type of economics that includes both normative or theoretical rigour and institutions, and therefore means a complement to traditional neo-classical microeconomics. As it will reviewed later, it looks at different types

[6]Contract law has the purpose of facilitating exchange. Classical contract law attempts to facilitate such exchanges by increasing discreteness (aiming at "spot" contracts where the parties come together for a one-off transaction) and intensifying "presentiation". The economic counterpart to complete presentiation is contingent-claims contracting-which involves comprehensive contracting. This means that all relevant future contingencies or unforeseen events are described and discounted based on their likelihood and time they may take to come (Williamson 1979).

The economic counterpart to complete presentiation is contingent-claims contracting-which entails comprehensive contracting whereby all relevant future contingencies pertaining to the supply of a good or service are described and discounted with respect to both likelihood and futurity

and levels of institutions, more specifically at institutional arrangements, governance structures and the institutional environment.

New Institutional Economics plays a central role in the conceptual framework of the research project for two reasons. First, the research object itself, innovative contracts are a particular kind of institutional arrangement. A second reason is the comparative nature of the project. Only when transactions costs -which are the costs that differ depending on the kind of institutions or governance structures- are taken into account, it is meaningful to compare the institutional systems and contracting structures of different countries. When transaction costs are neglected, the differences in contracting practices and governance structures are also not expected to have explanatory value, because in principle the performance and the costs of all of them should eventually lead to the same optimal results. As expressed by Groenewegen (2005) one shortcoming of standard economics is that it has no adequate explanation for the existence of different organizational forms.

Accordingly NIE is expected to contribute to the empirical analysis of different national contracting practices in many ways. Among others, by allowing the analysis of the context in which these innovative contract arrangements have developed and from this insight build more understanding about why similar contract arrangements have been more or less successful in different countries. And by facilitating the understanding of how these innovative arrangements have changed the game and its rules and their impact on the room for opportunistic behaviour, and if new rules are necessary in order to achieve the same or the desired levels of services and to ensure public values.

Transactions and contracts

The fundamental unit of analysis in TCE is the transaction. "A transaction occurs when a good or service is transferred across a technologically separable interface. One stage of activity terminates and another begins" (Williamson 1996, 379). Transaction is therefore synonymous with the economic concept of exchange. "A basic proposition of transaction cost economics is that the variety of contracts expresses the search for an adequate organizational response to substantial differences in the attributes of transactions they are designed to monitor" (Ménard 2002, 242). Meanwhile Furubotn and Richter (2000, 20) declare that "differences in institutional design may be attributed in large degree to the need to overcome enforcement problems".

Every transaction relationship involves three basic economic components: the allocation of value (or the distribution of gains from trade), the allocation of uncertainty (and any associated financial risks), and the allocation of property rights to decisions bearing on the relationship. These three dimensions are inherently interdependent; each one is likely to have implications for the others (Sykuta and Cook 2001).

An example of how these three dimensions interrelate in a lump sum or fixed price contract follows. On the one hand, this type of contracts eliminates nominal price

uncertainty. On the other hand, it may create financial risks for either side -principal and agent- as relative market prices change, for inputs or related products. In the same manner, a fixed price contract may also affect the incentives of the either contracting parts and the way they exercise their own decision rights, particularly with regard to product quality (Sykuta and Cook 2001, 2).

Institutional arrangements or governance structures

TCE as developed by Oliver Williamson, matches transactions with governance structures: if the transaction has specific characteristics (asset specificity, frequency and uncertainty), then the most efficient governance structure for the organization of such transaction is a market contract, a hierarchy, or a hybrid (Groenewegen and de Jong 2008). Transaction cost economics (TCE), as popularized by Williamson, also tends to focus on firm boundary issues-under what conditions an activity will be organized in an integrated, hierarchical manner versus in a more arms-length contractual manner (Sykuta and Cook 2001).

However, governance structures or institutional arrangements can be viewed in a continuum of coordination mechanisms ranging from anonymous spot market transacting to an autocratic hierarchy, with a range of varying degrees -often called hybrids- in between. Hierarchies can be seen as vertical co-ordination mechanism, integrated firms operating under forbearance law, and markets could be seen as horizontal co-ordination mechanisms. Different sorts of third way of coordination or hybrids are contracts (neoclassical contracts), associations, clubs, mutual adjustment and standardization of norms.

Governance structures are designed to mitigate the hazards, or minimize the costs, involved in effecting economic transactions. Transaction costs are the costs of running a system or the costs of gathering information, of co-ordination and motivation. Viewing the economic system from the stand-point of contract, transaction costs can be though of as the costs of contracting (Williamson 1996, 5).

The attributes of a transaction determine which coordination mechanism is expected to be the more efficient. Hierarchy would be for example the form that prevails when the level of uncertainty and/or the degree of specificity of assets involved is high enough to require integration. In other words as the assets involved in a transaction are more specific to the transaction, the potential for opportunistic behaviour increases, and the need for coordination between parties increases, the more likely hierarchical mechanisms will be used to govern the transaction (Sykuta and Cook 2001). In such a situation subordination is crucial and predominates over prices as the mechanism of adjustment (Williamson 1979).

Meanwhile in terms of contractual arrangements (governance mechanisms), this link between transaction attributes and coordination mechanisms suggest the following relationships. Markets would be the ideal form of organization for "classical contracts" where given the low specificity of assets the duration of contracts is short and prices

are the key variables. Instead "neoclassical contracts" characterized by high asset specificity that creates mutual dependency between partners and where therefore contract duration becomes more important and consequently there will be more need to adjust contracts, which will remain incomplete; would be better organized through hybrid organizational forms.

Williamson (1991) in his article "Comparative economic organization: the analysis of discrete structural alternatives" not only explains the key differences that distinguish three generic forms of economic organization -market, hybrid, and hierarchy- but how each of these generic forms is supported and defined by a distinctive type of contract law. He states that hybrid modes of contracting are better supported by neoclassical contract law.

Neoclassical contract law has emerged as a modified legal regime within the classical structure. It aims at accommodating some of the realists' (Macneil 1978; 1981) concerns regarding the rigidity of classical doctrine. Therefore, it relaxes classical rules by applying standards that allow for more flexibility. Nevertheless, it continues to adopt classical foundation principles such as offer, acceptance, consideration, and general performance duties. The neoclassical view, however, generally broadens classical analysis by allowing for contextual contract interpretation, and careful consideration of applicable trade custom and social values. As summarized by Williamson (1991) the neoclassical contract law of hybrid governance differs from both the classical contract law of markets and the forbearance contract law of hierarchies, being more elastic than the former but more legalistic than the latter. Neoclassical contracting refers to a different relationship that preserves trading but provides for additional governance structures and allows for third party assistance (arbitration).

In addition to classical and neoclassical contracts, Macneil (1974) proposed relational contract theory as an open, inductive, and individualized approach for analyzing and enforcing relations that do not fit classical or neoclassical, paradigms. Under such approach, each exchange no longer stands alone as in a discrete transaction but is part of relational web. Such "relational webs", are characterized by different durations, intricate personal interrelations, vague quantities and qualities, anticipation of future disputes and expectation of cooperative behaviours.Macneil (1978) offers a three-way classification of contracts -classical, neoclassical and relational- according to contract law. In terms of Macneil's three-way classification of contract, classical contracting mostly applies to all standardized transactions (independent of their frequency), relational contracting develops for transactions of a recurring and non-standardized kind and neoclassical contracting is needed for occasional, non-standardized transactions.

Beale et al. (2007) build on this classification of Macneil and refer to three types of governance mechanism and contracting schemes, depending on the level of standardization of the transaction and the frequency of it;

(1) *Market governance: classical contracting.* This is the main governance structure for non-specific transactions of both occasional and recurrent contracting.

Market alternatives are mainly what protect each party against opportunism from the other.

(2) *Trilateral governance: neoclassical contracting*. In such contracts the interest of principals (authorities) in keeping the relationship working is high given the high idiosyncratic nature of the transaction. This means that in this case the identity of the parties to the transaction matter and market relief is unsatisfactory. However, given the prohibitive costs of transaction-specific governance (such as bilateral governance and/or internal organization) an intermediate institutional form is needed. In this case, parties would rather opt for third party assistance than immediately opting for litigation, with its transaction-rupturing features. Third party assistance (arbitration) is applied for the solution of disputes and evaluating performance, e.g. the use of the architects as a relatively independent expert to determine the content of form construction contracts (Macneil 1978, 866).

(3) *Transaction-specific governance: relational contracting*. Here two options are proposed: Bilateral governance (obligational contracting) and unified governance (internal organization).

As has been mentioned before, this correspondence between transaction attributes and contractual forms has direct implications for the comparative analysis of contractive practices. Innovative contracts -characterized between others by the integration of different life cycle phases of the infrastructure, long-terms and the creation of bilateral dependencies- match better the definition of neoclassical contracts and hybrid forms, than that of classical contracts.

Behavioural assumptions: bounded rationality and opportunism

The main behavioural assumptions of TCE about economic agents are two, to be precise that agents are boundedly rational as well as potentially opportunistic. Bounded rationality refers to the fact that people (agents) are intendedly rational, but only limitedly so. Consequently even though economic agents may want to choose optimally, they are often unable to gather and process all the information necessary to make such an optimal decision. Not only information about future circumstances is incomplete but also the agent's cognitive architecture is restricted in various ways.

Opportunism is self-interest seeking with guile. This goes beyond simple self-interest seeking to include "calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse" (Williamson 1985, 47). But this assumption of opportunism in TCE is less offensive than at first would appear, since as Williamson states:

> To assume, moreover, than human agents are opportunistic does not mean that all are continually given to opportunism. Rather, the assumption is that some individuals are opportunistic some of the time and that it is

> costly to ascertain differential trustworthiness ex ante" (Williamson 1996, 48).

Moreover, the role of this assumption rather to serve as a warning those transactions may be subject to ex-post opportunism. Its significance in combination with the assumption of bounded rationality is rather constructive, so as to remember to "organize transactions so as to economize on bounded rationality while simultaneously safeguarding the transactions in question against the hazards of opportunism" (Williamson 1996, 48).

Bounded rationality implies (ex ante) incomplete contracting and potential opportunism implies (ex post) moral hazard. Real contracting problems only occur if both behavioural assumptions hold. Firstly, if rationality had not restriction then even if agents would act opportunistically that would not represent significant harm as each of these circumstances would be already handled or anticipated by a comprehensive contract. Secondly, if bounded rationality holds preventing the anticipation of such circumstances, but agents are not considered prone to behave opportunistically, also no significant threat is present as agents are expected to respond in an honest and cooperative manner to any of such circumstances.

Variety of contracts and enforcement procedures

The variability in contract forms has been observed and analysed by different studies of institutional economists. Various cross-sector and cross-national studies have supported the notion of variability among contracts corresponding to a variability in transactions and their (national) environments (Ménard 2002). Different works have empirically corroborated the relationship between attributes of the transaction at stake and contract characteristics; i.e. the strong correlation between asset specificity and contract duration (Palay 1984, Joskow 1987).

In spite of the observed variety in contracts it seems still possible to classify them based on a limited number of variables, as "variation among contracts arises from the combination of a small number of clauses that specify different terms" (Ménard 2002, 239). A first operational typology has been proposed by Williamson (1985, in Chapter 3), who classified contracts based on three variables: prices, asset specificity and safeguard clauses. Alternatively, Laffont and Tirole (1993) make a classification of procurement contracts based on the incentive scheme applied. They define "cost-plus-contracts" and "fixed-price contracts" as opposite ends of a continuum, where "incentive contracts" lie somewhere in between. In a "cost-plus" contract the government pays the contractor his/her realized costs and sets a fixed fee, independent on the actual performance. For this reason is considered a low-powered scheme. At the opposite end, is the "fixed-price" contract; where the government does not de facto reimburse any of the costs, it pays only a fixed fee (Laffont and Tirole 1993, 7). Under such scheme the winning firm is residual claimant for its cost savings and this is considered a high-powered scheme.

Nevertheless, for the purpose of this research a more recent typology developed by Ménard (2002) has been adopted. He revises and enriches Williamson's typology to give more importance to coordination mechanisms in contracts and enforcement devices; both elements particularly relevant in the new contracting setting in the road sector.

According to this typology variability among contracts can be summarized into four factors: contract duration, degree of completeness, incentives and enforcement procedures.

Duration

Contract duration differs. In most empirical studies and surveys referred to here, duration is closely related to the attributes of the transaction at stake. The more specific are the investments, the more the continuity of the relationship matters, and the longer is the duration of the contract (Palay 1984, Joskow 1987). All in all, duration signals the commitment of the partners.

Degree of completeness

The degree of completeness of a contract is the degree to which contingencies are more fully specified. A complete contract specifies what each party has to do in every possible situation and arranges the distribution of realized costs and benefits in each contingency so that each party individually finds it optimal to follow the contract's terms.

In Ménard's typology the degree of completeness makes reference to variables of adaptation; prices, quality, quantities, delays, and penalties. The notion that the degree of completeness in contracts increases with the level of asset specificity and decreases with uncertainty has been supported by a number of studies (Palay 1984, Joskow 1987, Ménard 1996). These associations suggest a trade-off between security, required by substantial dependency, and flexibility, required by changing circumstances Ménard (2002, 240). In a similar fashion, Williamson (1991) expresses that from an economic point of view, the trade-off that needs to be faced in excusing contract performance is between stronger incentives and opportunism; excuse doctrine should therefore be used sparingly. A more elaborated discussion on this trade-off -depicted as a trade-off between the technical characteristics of design freedom and flexibility versus the safeguarding of public values- will be presented in Chapter 3.

Incentives

Contracts deal with this problem partially through incentives, the third factor of differentiation. Although parameters may vary widely (e.g., the actual unit prices of different construction materials), there are only a few basic kinds of incentive mechanisms, which are less complex than the standard theory of contracts tends to suggest

(Ménard 2002, 240). These mechanisms comprise piece rate systems, hourly wages, share distribution to employees, returns on assets paid to owners, and rent divided among partners to a joint project, with linearity or non linearity as a major characteristic.

Enforcement procedures

The fourth factor that distinguishes contractual arrangements is the enforcement procedures on which they rely. Within enforcement procedures are included more post-fact contracts, communication procedures and the like. Different types of enforcement procedures are possible.

Ménard's proposition is that as assets specificity plays a major role in the search for an efficient governance structure, uncertainty is the crucial factor in the choice of most adequate enforcement procedures of a contractual arrangement.

Accordingly, examples of enforcement clauses he suggests to use in contracts for which relatively stable conditions hold are automatic clauses of adjustment -which address changes simple to observe or to measure, like clauses that index prices- and hostage clauses, which often deal with failure of one party to fulfil the requirements or meet his commitments by setting penalties or specifying the quality or service level required. The complexity in applying such clauses emerges from non-observabilities.

Meanwhile in the case of contracts for which relatively unstable conditions hold, a combination of formal and informal or tacit mechanisms would be needed. Examples of clauses included as formal mechanisms are definition of zones of tolerance, within which adjustments will be made by the parties according to observable rules (e.g. adjustment of shadow toll payments according to different traffic levels observed) and, explicit mechanisms of arbitration, in case observability becomes an issue. Instead, informal mechanisms -needed when uncertainty is very high and/or safeguard clauses would be too costly to design- can be included without any explicitly or formal clauses stating their nature and role.

As mentioned before, a comparative advantage of this typology is the explicit and crucial role assigned to contract clauses dealing with the problem of enforcement. As summarized by Ménard:

> Contracts connect partners for mutual advantage, but at the same time they also generate the risk of disadvantage via opportunism, either because the contract is incomplete, or because conditions at the time of its implementation differ from those at the time of its negotiation, or both. The resulting temptation for one or more parties is to 'hold-up' the rent. This makes the assignment of rights a central issue, with enforcement procedures becoming crucial for the success or failure of the arrangement (Ménard 2002, 244).

Incomplete contracts and credible commitments

As explained before, self-enforcing contracts are the ideal according to agency theory. Nevertheless, this automaticity in the implementation of contracts often relates to its degree of completeness and complete contracts are actually not suitable to coordinate transactions that occur in an environment subject to unpredictable events or circumstances; as even if it could be possible to formulate such a contract, costs would be prohibitively high (Macneil 1978). In other words, self-enforcing contracts fit better the kind of transactions traditionally operated through markets, where price is a key coordination mechanism. This type of transaction corresponds with traditional contracting practices where short-term contracts are tendered and awarded mainly based on price.

Meanwhile, under conditions of moderate uncertainty the best options would be what Williamson calls "credible commitments". Credible commitments are at the core of contracts for which there is a high risk of opportunism. The role of credible commitment in contracts has been analysed by Williamson (1985; 1996), earlier contributors to relational contract theory and/or long-term contracting literature include Goldberg (1976), Macneil (1974) and Macaulay (1963).

Credible commitments and long-term contracting are of particular importance for the analysis of utility industries, given their high asset specificity (Goldin and Libecap 1994). The procurement of public infrastructures requires large investments in fixed production plants and distribution systems that are not mobile or easy to convert or to be sold for alternative purposes. Therefore, in order to invest in such assets, producers probably need assurances or guarantees -credible commitments- from potential consumers and/or government authorities that would prevent them from conspiring either confiscating the facilities or pushing for unrealistic prices or rates. At the same time, consumers also demand a similar commitment from the (private) utility company to take the risk on investing in the necessary equipment to access the service (electricity, gas, water and so forth). They have to trust that (private) producers are not going to suddenly start charging them monopolistic rates or providing them an irregular service. Often a state regulatory body that is responsive to both consumer groups and private producers has been one way to protect these investments and to provide consumers and utilities with the necessary commitments (Goldberg 1976, Williamson 1985, 327-364).

Noteworthy is that the conditions and properties of credible commitment match particularly well with characteristics of what Williamson called "neo-classical contracts", and that as previously mentioned seem to be the proper label for innovative contracting practices.

> Credible commitments are particularly fit for transactions that put partners at risk, because they involve specific investments, in an environment where changing conditions open possibilities for opportunistic behaviour, while replacing partners would be costly. This corresponds quite closely

> to the description of contractual arrangements that prevail in hybrid organizational forms (Ménard 2002, 250).

Given the inherent incompleteness of this type of contracts (hybrids), disputes are more frequent and more difficult to solve. They are also less likely to be resolved by formal enforcement procedures, such as litigation; partly because in such contracts the interest of principals (authorities) in keeping the relationship working is higher and formal procedures have often transaction-rupturing features. As mentioned before, a preferred option for the solution of disputes would be third party assistance (e.g. arbitration).

The role of the institutional environment

The institutional environment is the man-made constraints that structure political, economic, and social interactions. It delineates the rules of the game within which the institutional arrangements (governance structures) actually operate, and it also prescribes the rules of conduct within which human actions take place. Two differences between the institutional environment and the institutions of governance stated by Williamson (1996) are; firstly that the former mainly defines or can be thought of as constraints on the environment of the latter; secondly that the level of analysis of each is very different. Institutions of governance operate at the level of individual transactions while the institutional environment deals with composite levels of activity.

The institutional environment consists of the basic formal and informal rules in a society and the so-called social capital. Formal rules include laws and rules of society and the way these are enforced and monitored. It also includes sanctions and conflict-resolving mechanisms. Informal rules instead consists of common codes of behaviour, sanctions, customs, traditions, norms, values and belies; deeply rooted in a particular society. Social capital is the glue that holds society together and facilitates cooperation. It is the repository of shared understanding, norms and rules that translate in expectations about patterns of interactions that brings groups of individuals to a recurrent activity. The most important component of social capital is trust. It is assumed that a small amount of social capital in society leads to higher transaction costs. Trust plays important role outside, but also between and within the organization as higher trust would translate in lower search and monitoring costs and lower contracting and control costs.

The institutional environment is expected to vary among countries and even within countries the basic rules are not expected to be always the same. As it will be explained again later, some parts (or levels) of the institutional environment are more dynamic and could change rather fast while other levels may take more than decades to record a change. Many studies have gathered empirical evidence for the notion that the institutional environment has a powerful influence on the performance and duration of contracts (Levy and Spiller 1994, Shirley 1995). The institutional environment, more concretely the characteristics of the regulation and credibility of the authority, deter-

mine the capacity to enforce the contract and are therefore decisive for the adoption and success -or performance- of specific contractual forms.

The four layers of institutions and their pace of change

Figure 2.5 shows four layer schema of Williamson (1998). This layered scheme shows the complexity involved in understanding process of change and evolution of institutions, and issue which will be discussed in greater detail in the following section. In this figure the economics of institutions which has been reviewed in this section, is presented by showing that governance structures (layer three) are linked and affected by a broader institutional context.

As shown in the figure the different layers contain different types of institutions. Layer one, social embeddedness refers to common values and norms and informal rules; layer two, the institutional environment refers to formal rules of the game, such as how a society deals with property rights; layer three, governance structures layer, refers to the specific coordination mechanisms such as markets, hierarchies and hybrid forms. Finally, layer four, resource allocation and income distribution layer refers to variables such as prices and quantities, and (monetary) incentives.

As pointed out by the frequency in years of each layer, the pace of change of each of these layers varies significantly; with informal institutions taking the longest time to adapt -more than hundreds of years- versus the time required to change formal governance structures, up to ten years.

In the very long term the whole system is interconnected, but for the purpose of the analysis realized by Williamson -using a shorter time horizon- he opts to neglect the feedbacks; presented in the figure as dotted arrows. Meanwhile these arrows are considered as solid ones by old institutional economists, which as it will be explained later, assign a higher importance to history and tradition.

2.4.4 Strengths and limitations of New Institutional Economics

NIE and more specifically TCE have proved useful for addressing the research question. The theory developed by new institutional economists allows for the empirical and comparative study of contracting practices in different countries, by providing the necessary concepts not only to analyse the variability in transactions and corresponding contractual arrangements but also to address the variability in their environments. The four layer scheme of Williamson (1998) proves particularly useful in this respect. Nevertheless, the consideration of higher levels of institutions constraining governance structures -in our case hybrid contractual arrangements- adds an additional dimension to the research, that of time and with it the need to include concepts that are able to deal with this dynamic.

Besides, as pointed out by Ménard an interesting question concerns the continuous coexistence of different contractual arrangements even within the same sector and

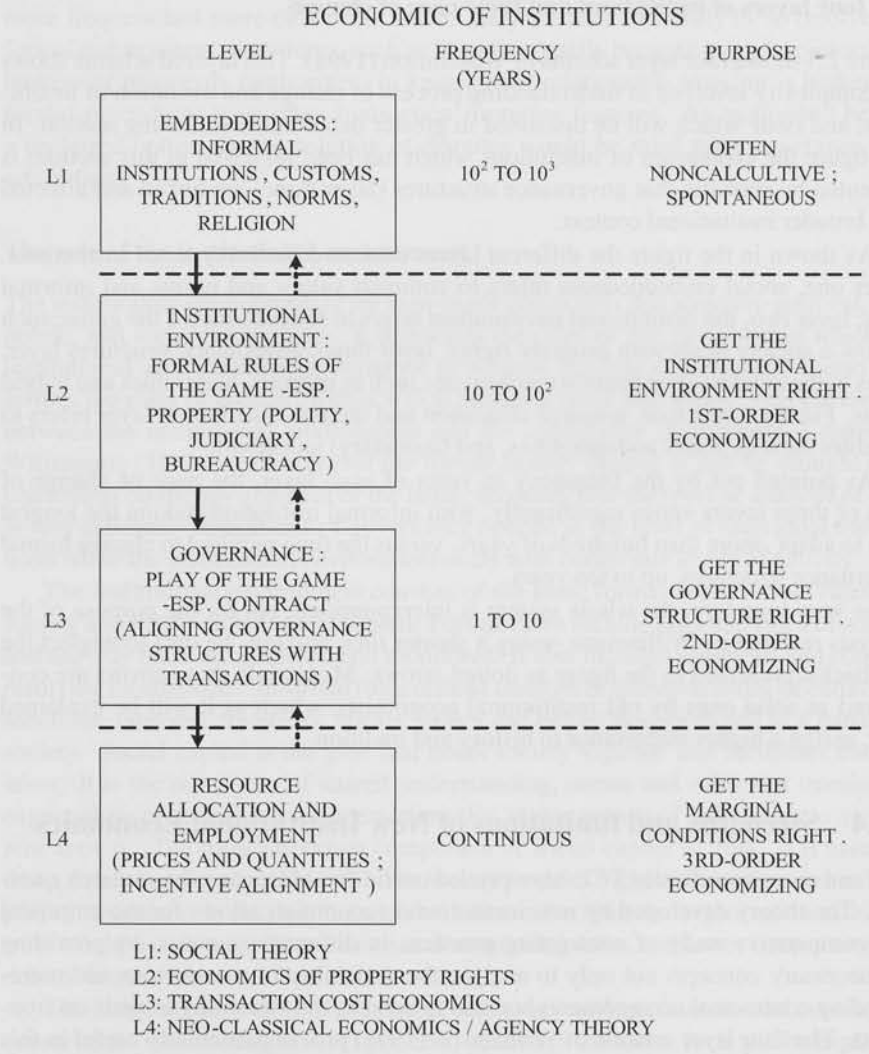

Figure 2.5: *The four layers if institutions. Source: Williamson (1998, 26)*

within the same institutional environment, which in our case translate in a variety of contract types used by the same national road authority. He explains this as follows:

> One possible explanation for this durable diversity of contracts within the same class of transactions is of a dynamic nature. Path dependency, which creates social patterns of behaviour, may promote the survival of otherwise less efficient contractual arrangements (Ménard 2002, 239).

The concept of path dependency as well as other notions required for the explanation of such dynamics will be reviewed in the following section.

2.4.5 Key concepts in Evolutionary Economics and Old Institutional Economics

Central in this research is the issue of understanding the evolution of the different national procurement practices and strategies. It is for this reason that the present section focus on reviewing economic theories that contribute to the analysis of institutional evolution.

In the study of institutions different theoretical bodies and research schools can be distinguished. First, a distinction can be made between the Old Institutional Economics (authors such as Veblen, Mitchell, Commons, Ayres, Gordon and others) and the New Institutional Economics (authors such as Williamson, North, Langlois and others). Within these two, there are more specific research schools like the so called Comparative Institutional Economics (CIA) with writers as Aoki (2000a;b; 2002) and Evolutionary Economics or the Economics of Increasing Returns with authors such as Arthur (1989; 1990; 1994).

Rutherford (1994) points out that the dispute between the Old and the New Institutional Economics centres on five main issues:

(1) Formalism versus antiformalism, the role of formal theoretical modelling as opposed to less formal methods, including historical and "literary approaches",
(2) Individualism versus holism: the emphasis to be placed on individual behaviour leading to social institutions as opposed to the effect of social institutions in moulding individual behaviour,
(3) Rationality versus rule following, the validity of rationalist explanations as opposed to those that place limits on the applicability of rationalist conceptions,
(4) Evolution versus design: the extent to which institutions are the result of spontaneous or invisible-hand processes (resulting from the maximization behaviour of each individual) as opposed to deliberate design, and
(5) Efficiency versus reform, the basis on which normative judgments can be made, and the appropriate role of government intervention in the economy.

In this section only the difference regarding the way these different research schools conceptualize evolution will be explored.

How do institutions change?

Central for understanding the roots of the differences between the contracting practices of different countries is to analyse how these different systems have evolved. As Greif (1998) points out, among the most fundamental questions of institutional economics are: "Why do societies evolve along distinct institutional trajectories? And, why do societies often fail to adopt the institutional structure of more successful ones?"

Standard or Neoclassical economics is quite static in its point of view. For standard economics just one single and most efficient equilibrium point is possible and therefore, independent of the history or initial conditions of the system, all economical systems should evolve until they reach the ideal and most efficient equilibrium point. This equilibrium point is inspired on the Walrasian model and the American model is considered its nearest approximation. The idea of a single equilibrium point is coherent with the assumption of scarcity of resources and the law of decreasing returns.

New Institutional Economics (NIE) is richer in its analysis and through the inclusion of the concept of transaction costs opens up the possibility of different arrangements or governance structures being the most efficient dependent on asset specificity, frequency and uncertainty in the transaction (Williamson 2000). Nevertheless, it keeps many of the static and formal assumptions of neoclassical economics. Even though different arrangements are considered plausible (e.g. hierarchy, market or hybrid), it keeps aiming at finding the most efficient governance structure for a specific transaction. The main reason for this similarity in conceptions is that NIE continues to assume the law of decreasing returns and rational maximizing individuals -with bounded rationality in the worst of the cases-, not directly influenced by exogenous or pre-existing institutions.

Though both Old and New institutionalism recognize that institutions may be deliberately designed and enforced or may involve in unplanned or "spontaneous" processes, the authors in NIE conceive the evolution of institutions more as a spontaneous and invisible-hand processes, unintended results of human action but not of human design. Meanwhile, the authors in the Old Institutional Economics (OIE) question this view and opt for a more design oriented one. Menger's central questions give us a clear impression of this tension:

> How can it be that institutions which serve the common welfare and are extremely significant for its development come into being without common will directed toward establishing them? (Menger 1883, 146)

Moreover, in what refers to the importance of history, OIE seems to give a higher weight to it than NIE and in this way seems to become more evolutionary. Veblen (1898) from the OIE tradition conceptualizes the evolution of institutions as one of a "genetic account of an unfolding process". He aims at a treatment of institutional

evolution as a process of "cumulative causation". For him, this cumulative process is based rather on habituation to material conditions and constraints -rule following- than on rationalistic calculation.

Rutherford (1994) highlights two important points rising from Veblen's notion of "cumulative causation". The first is the statement that institutional evolution should be conceived in a wider sense than simply the adjustment to a series of exogenously given shocks. In this sense, NIE seems to fall short because it does not deal with the internal dynamic of the system but only with the rational (or intendedly rational) responses of economic agents to exogenously given changes in population, technology, trading opportunities, or ideology. The second is that a discussion of cumulative causation involves a clear idea of path dependency.

This concept claims that history matters because the choices made earlier constraint the choices available in the future, what happens next depends critically on the present conditions, which is also the outcome of the pre-existing situation. Therefore, it also claims that small differences in initial conditions can make for widely differing outcomes.

These differences between NIE and OIE are only a general reading of the authors in these schools. A deeper view of their works shows that the dichotomies between traditions are also present within authors in the same tradition. Therefore, it could be more helpful to explore the theories of specific authors or the approaches of specific research schools instead of continuing with the comparison of the NIE versus the OIE view in general.

Comparative Institutional Analysis versus Evolutionary Economics

Two approaches will be discussed in this section, one coming from the Comparative Institutional Analysis (CIA) research program, particularly based in the works of Aoki (2000a;b; 2002) and one coming from the area of evolutionary economics, particularly based in the works of Arthur (1989; 1990; 1994) on increasing returns and path dependence.

Single equilibrium versus multiple equilibria

Both approaches recognize the possibility for the evolution of multiple equilibria. Aoki states:

> I have suggested that the convergence of the various economic systems that exist worldwide, and a complete convergence toward the Walrasian model in particular, would be difficult because of the variance in historical conditions among economies and the need for structural consistency between regulations and other institutions (Aoki 2000b, 5).

Arthur also makes reference to this when explaining what he found on the problems of interest to him (normally problems involving competition among objects whose

"market success" was cumulative or self-reinforcing):

> There was typically more than one long-run equilibrium outcome. The one arrived at was not predictable in advance; it tended to get locked in: it was not necessarily the most efficient; and its "selection" tended to be subject to historical events (Arthur 1994, xiv).

As already shown in their statements, similarities but also differences are found in the way they explain the processes from which these different equilibria result.

Design or spontaneous processes

Both authors seem to visualize these processes as spontaneous and invisible-hand, resulting from the choices of individuals aiming to maximize their gains but with bounded rationality. Bounded rationality means that individuals face constraints in their information processing capabilities as well as on their maximization calculation capabilities. This change towards bounded rationality is indeed what opens the possibility to more evolutionary explanations.

Institutional complementarity and path dependence

They both are concerned with the "inertia" of the evolving system. Nevertheless Aoki explains this inertia and resistance to change in terms of Institutional Complementarity[7], while Arthur conceptualizes this inertia or trend difficult to change as resulting from positive feedbacks in the system for which the initial conditions and "small events" in the beginning matter. He describes two characteristics for increasing return systems; the first, inflexibility, which refers to the possibility of lock-ins and the second, nonergodicity. About this second property he says: "historical small events are not averaged away and forgotten by the dynamics. History may decide the outcome". It seems clear that the conceptualization of Arthur accentuates the importance of history and "path dependence[8]".

Constant inertia or time dependent inertia

They also differ in the way they conceptualize this inertia. For Aoki this inertia of the system is to some extent constant, while for Arthur the inertia of the system increases

[7]Institutional complementarity means that the operations of one institution are reinforced by the existence of other institutions. The regulatory structure generally reinforces the system when it is internally consistent with other systemic elements. Each element of the institutional structure is mutually reinforcing. Thus an institutional structure will be resistant to environmental changes once it is formed. Attempts to change one institutional element independent of other elements will have only a limited effect Arthur (1994)

[8]The concept of path dependence explains how the set of options one faces for any given circumstance is limited by the decisions one has made in the past, even though past circumstances may no longer be relevant. The phrase is regularly used to mean one of two things; either that history matters, a broad interpretation; or to mean that institutions are self-enforcing, a narrow one (Pierson 2004).

after certain point, making a trend almost impossible to be changed. This difference can be seen in the following statements. Aoki (2000b) states: "Historical conditions extant (currently or actually existent) at the outset of the transition constrain the possible outcomes of the reform process, but they do not fully determine their later development". Arthur view instead says that heterogeneities, small indivisibilities, or change meetings -what he calls "small events"- become magnified by positive feedbacks to "tip" the system into the actual outcome "selected" (Arthur 1994, 27).

Decreasing versus increasing returns

As expected, the root of this difference can be found in their assumptions of decreasing returns versus increasing returns. Aoki (2000b) firmly states that:

> The reason for the evolution of multiple, sub-optimal organizational conventions is not increasing returns as focused recently in economics, but complementarity among strategic choices of agents (strategic complementarity.

He defines strategic complementarity as the process of selecting the strategy that corresponds to the prevailing social strategy. Meanwhile Arthur does believe that increasing returns (or positive feedbacks) are the reason for the evolution of different and hardly or non-predictable equilibria.

There are also differences in the way the resulting equilibria are conceptualized. Though Aoki leans towards a more evolutionary view than other authors in NIE, he stills sticks to the main assumptions of neoclassical economics, as the one that one of the possible equilibria is still the optimal one. This tension can be clearly seen in his work. He says "there is not absolute guarantee that the structure achieved will be the optimal one" (Aoki 2000b, 11). He even seems to indicate that sub-optimal equilibria (reached through rational individual decision) are possible, but he also states that really not efficient options are not possible equilibria. Thus he stills consider that the resulting equilibria will be always efficient and at worse, sub-optimal. Arthur is less confident in this respect and thinks that even though individual choices are rational, there is no guarantee that the option selected (between two technologies for example) is, from any long-term collective point of view, the better of the available options.

An important question remains: in spite of the inertia in the system, how does change take place? The CIA approach continues to consider external factors as the cause of change. Aoki (2000b):

> Though the institutional structure is inertia-driven, the structure and environment of the economic game underlying it will be affected by the development of production and information processing technologies as well as by the globalization of financial transactions.

To sum up, it could be said that Arthur goes further than Aoki in terms of evolutionary explanations and challenges important assumptions of neoclassical economics by assuming increasing returns instead of decreasing returns and the importance of initial conditions. Nevertheless in that way he also opens the possibility to explain the creation of multiple equilibria in a more dynamic and to some extent more consistent way.

Moreover, through the emphasis he puts on "small events" at the beginning that tip the development in a particular direction and the inclusion of the time dimension, though the formalization of the theory becomes certainly more difficult, it also becomes much more dynamic.

Arthur himself says in the preface of this book "Increasing Returns and Path Dependence in Economics":

> the increasing-returns world in economics is a world where dynamics, not static, are natural; a world of evolution rather than equilibrium; a world of probability and chance events (Arthur 1994, xx).

2.4.6 Summarizing the contribution of evolutionary theories

In order to explain the differences in national contracting practices and procurement strategies and their evolution, the chosen research conceptual framework is more in line with the notions and assumptions adopted by evolutionary economists such as Arthur and in few cases rather in line with the view of Old Institutional Economists such as Veblen, Mitchell, Commons, Ayres, Gordon and others. In other words, multiple equilibria are possible, institutions are not merely the result of spontaneous or invisible-hand processes but partly also the result of deliberate design (through the power exerted by certain actors); the relative inertia of the system can be explained mainly by history and path dependency and therefore inertia is time dependent. Finally, as Arthur proposes the idea that increasing returns (or positive feedbacks) are the reason for the evolution of different equilibria is adopted.

All in all the theories and notions reviewed offer great potential for the modelling of evolutionary processes where multiple equilibria are possible, where historical events and initial conditions do make a difference and where the time domain needs to be included.

Nevertheless, none of the evolutionary theories reviewed seems to make explicit mention of the role of power -exerted by different actors or stakeholders- as explaining mechanism for the introduction of change or inertia in the system. This does not mean that economists from different subdisciplinary fields have not invested efforts on exploring the concept of power and its role on economic life.

An example is the contribution of A. Allan Schmid with his book "Property, power and public choice. And inquiry into law and economics.". In his book he aims at enriching public debate with value judgements beyond the ones proposed by conventional theory which limit the policy debate to the rights highlighted by the models of

pure competition. His work argues for the inclusion of knowledge, psychology and power variables in institutional economics[9].

As he presents it, orthodox economics focuses on "consumers and asks whether the economyc system delivers efficiently what consumers want, given availabe resources, technology and consumers wants" (Kanel 1974, 382). "The only power variable that arises from this is controlled by budget constraints and competitive markets" (Schmid 1978, 4). Schimidts argues that resource ownership and competition address only a portion of human interdependence and thus only a portion of the sources of power that affects the questions of those whose interests count, both as consumers and produces. "It is public resolution of power conflicts that determine what is efficient" (Schmid 1978, 4).

Nevertheless up to now, economic analyses tend to neglect these other dimensions or sources of human interdepence that in their integrity define the role and the power of actors.

A pragmatic solution to this shortcoming is to adopt a number of concepts -such as power or influence- current in other social sciences, especially in political science and sociology, as suggested by Groenewegen and de Jong (2008) in their article "Assessing New Institutional Economics' Potential to Explain Institutional Change". As will be discussed in greater detail in Section 2.5 on research methods, such concepts are made operational in the research by applying the methodology of stakeholder analysis. The adoption of stakeholder analysis, particularly ex-post is becoming increasingly common in economic studies (Langlois 1986, Dunleavy 1991, Seo and Creed 2002, Henisz and Zelner 2004)).

Political scientists have often defined power as the "the ability to influence the behaviour of others". MacMillan (1978) separates the concepts of power and influence. He defines power as the capacity to restructure actual situations and influence as the capacity to control and modify the perceptions of others.

In lesson-drawing research as well as in stakeholder-analysis the notion of power or influence is complemented by the consideration of stakeholders' positions on the reform issue, influenced by their political values and/or their (vested) interests. The importance of considering such attributes of actors is well formulated by Rose: "Failure to take into account the values of the dominant coalition in government will leave a lesson in limbo; it can be applicable, but if politically unacceptable, it will not be applied" (Rose 1993, 15).

2.4.7 Key concepts in engineering design

It is hard to define design in general terms, as it is to define the particular endeavour of engineering design (Dym and Little 2004, 11). Design could be for example defined as

[9]Institutional economics can be divided into institutional-change theories and institutional impact theories (according to Pryor (1973, 28)). The book of Allan Schmid focuses on impact theories, while this research focuses on institutional change.

a goal-directed activity, performed by humans, and subject to constraints. The product of the design activity is a plan to realize those goals. Herbert A. Simon, Nobel laureate in economics and founding father of several fields, including design theory, offered a definition that is closely related to the engineering concerns but at the same time offers a broad point of view; as an activity, design is intended to produce a "description of an artifice in terms of its organization and functioning - its interface between inner and outer environment".

His definition is interesting for engineers since it places designed objects in a systems context, in which it is explicitly recognized that an artefact must operate as a part of systems that includes the world around it.

In order to understand the concept of design freedom and why road agencies around the world expect that integrated contracts will result in higher levels of innovation and in savings in terms of total life cycle cost (LCC) of the infrastructure; the methodology of system-level design and the concepts it uses are important.

System-level design

System-level design is an umbrella term for the earliest design phases. It is concerned with investigating whether (alternative) conceptual solutions for realising the desired functionality will lead to satisfying the non-functional requirements if such concepts would be used as starting point for realising the system. Structured approaches for performing system-level design are required to deal with the difficulty of making the right choices during the earliest design phases and in this way also minimize design time.

Design specification

The trajectory from idea to artefact involves the development of a desirable but a priori unknown realization based on an initial specification. The specification prescribes concisely the requirements for a system, such as its functional behaviour and other characteristics.

Design alternatives

In order to realize the functionality prescribed by the design specification, there are often a number of alternative solutions that can be formulated. Such alternative solutions are called design alternatives.

Design space

In system-level design, design space refers to the virtually unlimited number of all possible design alternatives that can be realized with known technology (or new technologies). Nevertheless only a limited number of design alternatives within the design

space can satisfy all requirements for a system (feasible designs); or in the case of contracting all requirements formulated by the road authority. As it will be explained again later, the term design space and/or design freedom will be used to refer to this small subset of alternatives.

Degree of specification of requirements

In the trajectory from idea to artefact, consecutive design phases focus on refining the amount of detail with which the question on how to realize the specified functionality is answered.

As explained before, only a limited number of design alternatives in the design space can satisfy all requirements for a system; which include functional and non-functional requirements. Functional requirements define what a system is supposed to do -describe specific and necessary system functions- whereas non-functional requirements define how a system is supposed to be. Not succeeding in meeting functional requirements may result in system failures. A design is said to be correct if it satisfies all functional requirements. Meanwhile non-functional requirements relate to criteria that can be used to judge the operation of a system, rather than specific behaviours. They relate to the remaining characteristics of a system and are often called qualities of a system, or alternatively "constraints", "quality attributes", "quality goals" or "quality service requirements". Examples are operational costs, maintainability and performance properties. A correct design that also satisfies all non-functional requirements is called a feasible design. The design process can therefore be described as the progressive search for a feasible design.

In a similar fashion, the degree of specification of requirements that make part of a contract, refers to the level at which the design goal is specified. As it will be explained in greater detail in Chapter 3 -under performance contracting- contract requirements may be expressed in terms of outcomes (or system goals), performance requirements, functional requirements and technical specifications; each one successively constraining the decision rights of the private contractor.

Abstraction pyramid

An easier way to understand the concept of degree of specification and its relationship with design space is depicting the so-called abstraction pyramid. As mentioned before, at each design level, a number of options can be considered for adding details on how to realize certain functionality. Such process implies the need to explore design alternatives and decide which one will most likely lead to optimal fulfilment of requirements. Figure 2.6 shows a 3D-version of the so-called abstraction pyramid. This pyramid demonstrates how design choices taken at successive levels advance the design from an initial specification to a system ready to be realized.

Choices or concepts formulated to realize the desired functionality right at the beginning will directly restrict the number of possible designs (design alternatives)

that can result from the design process. Decisions taken during consecutive levels will continue to restrict the number of possible resulting designs until a single realization is found. In other words, the options available to the designer(s) or private contractors in charge will gradually decrease. The design space available to the designers will evolve from a large, broad set of design variables, to a small, confined set of design variables.

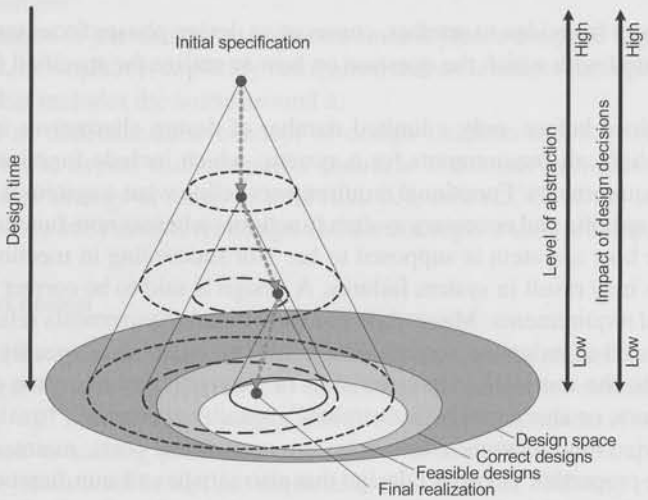

Figure 2.6: *Abstraction pyramid: design alternatives at different design levels. Source: System-Level Design with the SHE Methodology, Department of Electrical Engineering, Eindhoven University of Technology, 2008. July 20 2008. Available at:* `http://www.es.ele.tue.nl/poosl/`

In the case of infrastructure systems this progressive reduction of design space moves along two important dimensions; the system scale dimension and the life cycle dimension. Accordingly, the impact and the importance of the choices taken are expected to be far greater earlier in the design process. As it will be explained later, their influence is to be measures not only in terms of system functionality but also in terms of system performance such as total costs of ownership of the facility.

The system scale

The system scale describes at what system level the designers make their decisions. In the design of infrastructures these levels could range from a whole infrastructure system (e.g. regional road network) all the way to system components (e.g. a bridge or a shoulder) and even elements (e.g. layer of asphalt or bridge column); passing through systems (e.g. a transportation corridor), and sub-systems (e.g. a particular road section).

Infrastructure life cycle

A typical infrastructure systems life cycle consists of the following phases: need analysis, conceptual design, basic design, detailed design, construction, commissioning and start up, operations and maintenance, upgrading / retrofitting or revamping and phase out and decommissioning (Ajah 2009).

Need analysis is the process of identifying and evaluating needs. The identification of needs is a process of describing "problems" of a target population and possible solutions to these problems. Such analysis focuses on the future, or what should be done. In a similar fashion, the plan to deliver a new infrastructure facility or project starts with a need analysis or so-called infrastructure needs assessment. Such assessment is therefore realized long in advance before a project is open to tender, as part of national strategic coordination initiatives. During the conceptual design, the system is analysed to determine the conceptual feasibility of alternative processes and based on this understanding, select a number of feasible design alternative(s) amongst the tens of thousands available up to then. This smaller set of selected options is then passed on to the following basic and detailed design phase. During these two phases, this selected subset of alternative(s) are worked out further up to more technical details, as much detailed as necessary for the construction of the infrastructure system or facility required, which is the next phase of the life cycle.

Besides the initial need analysis, the following three phases -conceptual, basic and detailed design- are the major design phases in the life cycle of the facility and accordingly they account for the greater percentage of where the most important decisions are taken (Ajah 2009). Accordingly, designers as well as any other stakeholders involved in the design process (e.g. private contractors) have the maximum degrees of freedom in influencing the final result and all facility attributes, early in the life cycle, especially right at the start, during the need analysis and conceptual design phase.

As ones advances along the life cycle phases of the system, the degrees of freedom decrease exponentially, placing limits both of a technical and a financial nature to any possible changes desired (e.g. functional or performance requirements). The significance of the choices taken early in the design process is not only based on the loss of flexibility, but equally important, also in terms of costs. A larger percentage of the total life cycle costs (LCC) or total costs of ownership (TCO) of a facility are already decided precisely during these early design phases, while the design activities themselves represent a relatively small proportion of this total LCC, often less than 10%. Ajah (2009) suggests that there is a Pareto relationship between the future costs being fixed or committed in advance at this stage, and the amount actually spent in these design stages.

The fact that design decisions taken earlier in the design process have in general a bigger impact on the properties of the final realization than those taken during later phases, is particularly relevant in the context of innovative contracting practices. This means that in road projects, for example, decisions taken during early design phases

have a higher impact on the maintenance strategies that would be feasible in the future and therefore on the total life cycle costs of the infrastructure; than choices made during the detailed drawing stage or during the project execution. Maintenance costs of road transport facilities are estimated to represent around 80% of total LCC.

2.4.8 Dynamic comparative framework of national procurement models

The development of a research strategy has meant a process of continuous enrichment of the conceptual framework with notions and assumptions adopted from different theoretical bodies. The main steps followed in this process as well as the contribution of each of these theories to the analysis of contracting practices follow.

Before presenting this process it is important to discuss the issue of theoretical heterogeneity and whether the use of different theoretical frameworks or perspectives pose a problem for the integrality and/or quality of this research.

The author's opinion is that even though (often) these theoretical frameworks are often seen as competing or conflicting -given the different assumptions in which they are based (e.g. about rationality of actors)- they do not ought to be conflicting, specially when each of these theories serves a different purpose within the research (overall analysis). The (common) perception of conflicting theories may originate from the fact that (some of) their application areas have been ill defined. The pragmatic approach proposed here may in fact contribute to a better understanding and delineation of their areas of application.

Besides and equally important, the use of these frameworks in a complementary fashion may be justified by the nature of the research, classified as a problemistic search or what is called by Rose as "Lesson-drawing in public policy". As explained before, lesson-drawing research requires concepts, which in fact have more importance than theories in this type of research, as they determine the questions one asks and therefore the answers one gets.

Last but not least, it is important to clarify that in the case of the game Road Roles, the element of the research within which behavioural economics1 is most applicable, not particular kind of actor has been assumed. In fact, participants are let free to make their own choices in strategy (egoistic, cooperative or altruistic) and their own assumptions about the behaviour rules of the other players.

First, agency theory in combination with few concepts from engineering design (called the simple theoretical framework) is used in a first analysis of the problem and of the system, shown in Figure 2.7 and will be presented in the first section of Chapter 3. Here a first formal and fairly theoretical analysis of innovative contracts in general -without specifying the three different markets- is presented. In accordance with the assumptions of agency theory, in this first analysis contracts are considered as

self-enforcing, closed system or self-containing, without considering the influence of institutions.

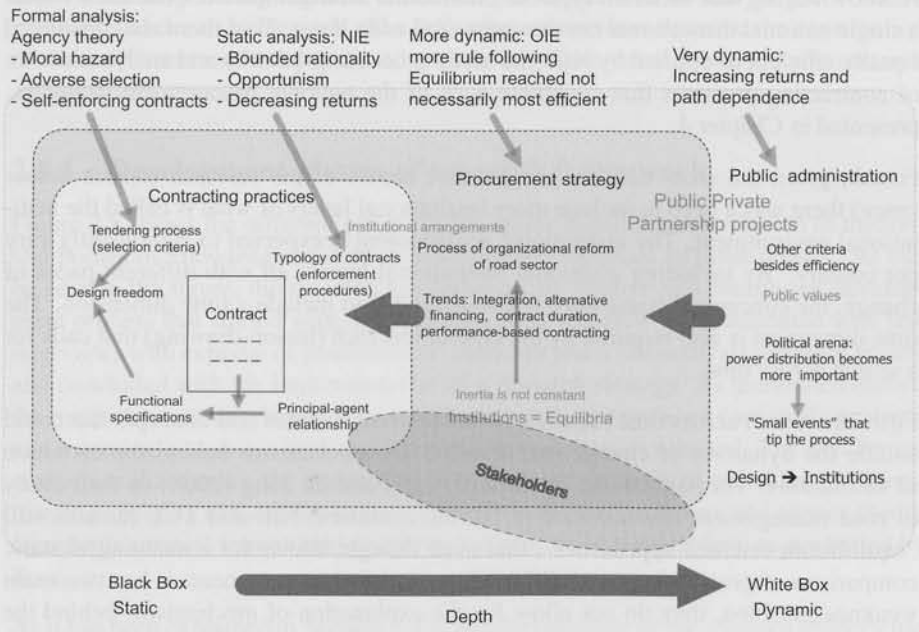

Figure 2.7: *Elements of the dynamic comparative framework*

Second, from this first formal analysis it became clear that the implementation of innovative road contracting practices (longer duration, transfer of risks and higher uncertainty) have meant a change from "classical contracts" to "neoclassical contracts". The situation in road management before the recent reforms and implementation of new contracting practices was a combination of hierarchical coordination mechanisms (with parts of the organization realizing directly works) and markets created ad-hoc for certain activities or tasks. As pointed out agency theory applies rather to classical contracts where the self-enforcing assumption could still hold and one could aim for complete contracts, better coordinated through markets and where prices are the key variables. Meanwhile, "neoclassical contracts" (incomplete, longer term, more uncertainty and risks to parties) could be considered more a hybrid type of institutional arrangement, within the spectrum between markets and hierarchies.

Third, from the combination of these two premises the need to widen the conceptual framework and include institutions and consider the variety in contractual arrangements (within one single national system) becomes clear. The notion of contracts as institutional arrangements put forward by NIE and TCE is then adopted; together with

concepts like enforcement mechanisms -formal and informal- and typologies of contracts depending on the type or nature of the transaction that needs to be coordinated. Acknowledging that different types of contractual arrangements coexist even within a single national institutional environment -and even if not all of them are considered equally efficient or optimal by NIE- the study proceeds to portray and analyse the mix of contracting practices that constitute each of the national procurement strategies; presented in Chapter 4.

Fourth, given the cross-national comparative nature of the research (search across space) there was a need to include more institutional layers or what is called the institutional environment. The institutional environment is expected to significantly vary per country. By including additional institutional layers, all with different paces of change, the conceptual framework is also extended to include a time dimension. The time dimension is also required by the type of research (lesson-drawing) that calls for a search across time.

Fifth, the search across time requires the adoption of theories and concepts that could handle the dynamics of change and describe the mechanisms behind the evolution of institutions. As pointed out by Groenewegen and de Jong (2008) in their study of road management liberalization in Nordic countries, NIE and TCE remains still "equilibrium oriented approaches", that even thought allows for a meaningful static comparison of pros and cons of different institutional arrangements it has two main weaknesses. First, they do not allow for the explanation of mechanisms behind the evolution from old to new equilibria. Secondly, as institutional environments are described at such high level of aggregation; subtle institutional differences between countries are often overlooked or deemphasized and "therefore in most cases it cannot account for nuanced differences in path-dependency and final equilibria reached in specific institutional (sub)systems or countries" (Groenewegen and de Jong 2008, 24).

Consequently the conceptual framework needs to be extended even further to adopt essential notions from evolutionary economics and OIE such as path-dependency and from social sciences such as power (exerted by different stakeholders). These two notions are influential for the analysis realized in Chapter 5, were is illustrated how initial conditions, path dependency and the power exerted by different interest groups of actors, has been decisive for the outcomes of the different national reform processes.

2.5 Research methodology

As previously stated in Chapter 1, the main research question is: *How to achieve the results expected from innovative contracting -mainly improvements in efficiency and innovation- while keeping the room for opportunistic behaviour (of contractors) and the (negative) effects of it at the minimum possible?*

In order to answer this normative question, besides the development of a (conceptual) research framework, a series of research techniques and methodologies was applied not only during the data collection phases but also to analyse the evidence gathered and draw conclusions. The following subsections describe the contribution of these different methodologies and explain in greater detail the case study research implemented.

2.5.1 Development phases of research framework

Figure 2.8 shows the different phases of the research and the contribution of theoretical bodies of knowledge as well as practitioners' literature to these phases. As can be seen in the figure, the research has followed an iterative and continuous development process that started with a preliminary desk research -complemented with few interviews with experts- of practitioners' literature and a (theoretical) literature review and concluded with the implementation of a research strategy. As mentioned earlier, the main elements developed as part of the research strategy are a case study protocol and a gaming-simulation tool applied in the three countries selected. The first formal analysis realized takes the findings of a preliminary research of practitioners' literature and applying to these the notions of engineering design theory and agency theory (simple theoretical framework) results in a diagnosis of the problem, as suggested by Rose.

As it has been explained in Section 2.4.8, the development of the research strategy has meant a process of continuous enrichment of the conceptual framework with notions and assumptions from different theoretical bodies.

2.5.2 Research methodologies and techniques

A comprehensive study and analysis of different national procurement systems requires the use of a variety of research techniques.

System analysis

Systems methodology or the systems approach refers to a set of conceptual and analytical methods used in systems thinking and modelling (Cavana and Maani 2000a). The general methodological approach towards systems thinking and modelling applied in this research is based on the system dynamics method. Some authors in fact make the distinction of two elements within the systems thinking approach; and name system analysis the conceptual part and system dynamics the practical application part (Haraldsson 2004).

The system dynamics method was developed by Forrester (1961) and others at the Massachusetts Institute of Technology in the late 1950s, based on developments following World War II in, particularly in: (a) the theory of information feedback

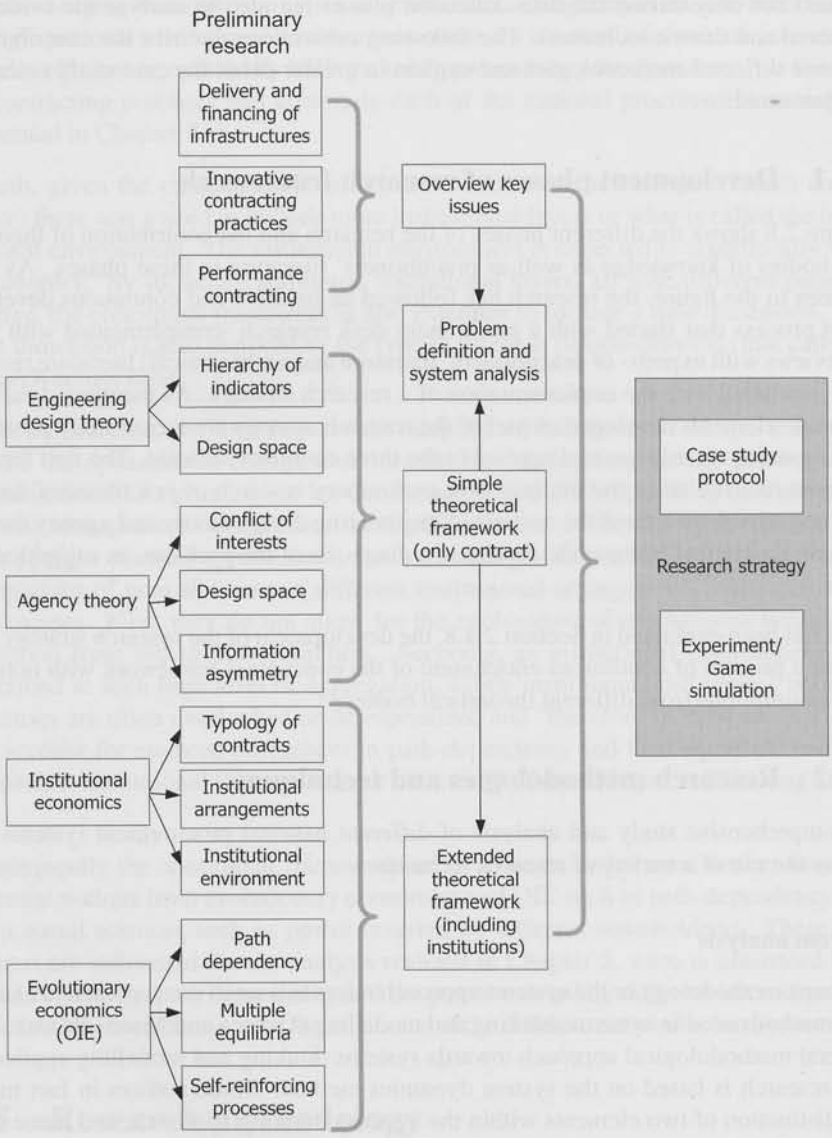

Figure 2.8: *Research framework*

systems; (b) the understanding of decision-making processes; (d) the use of mathematical models to simulate complex systems; and (e) the development of high-speed electronic digital computers as a means of simulating mathematical models (Cavana and Maani 2000b).

When a problem is first encountered, the information is normally quite unsorted and disorganized. Often we are presented by a mixture of issues, problems, symptoms, worries, complaints, proposed mechanisms and fragments of solutions (Haraldsson 2005). In order to make sense, it must be sorted, organized and structured. System thinking offers a systematic methodology through which all this information can be organized to arrive to an explicit and clear definition of the problem at hand and its causes. Accordingly, this methodology proves particularly rewarding for the analysis of multidisciplinary and/or complex problems, as is the case of the management and procurement of national road networks.

The development of a systems thinking and modelling intervention (ST&M) involves five major phases, each of them involving a numbers of steps (Cavana and Maani 2000a): problem structuring, causal loop modelling, dynamic modelling, scenario planning and modelling, and implementation and organizational learning. This does not mean that a ST&M intervention requires all phases to be undertaken, the phases and steps proposed only serve as guideline. The choice of which to apply depends on the issues or problems that have generated the systems enquiry (Cavana and Maani 2000b). For the purpose of the research the phases applied were problem structuring and causal loop modelling (presented in Chapter 3).

During the problem structuring phase, the situation or issue at hand is defined and the scope and boundaries of the study are identified. During the causal loop modelling phase conceptual models of the problem, known as causal loop diagrams (CLDs) are drawn. CLDs are a major component and the most commonly used element of the systems thinking approach (Cavana and Maani 2000b).

The causal loop modelling phase often involves the following sub-steps: identification of main (key) variables, development of CLDs or influence diagrams to illustrate the relationships between the variables and; analysis of the different causal loops identified through the CLDs which determine the behaviour over time of the system under analysis. CLDs are visual representations of cause-effect relationships in a system. Such relationships are represented by arrows between each pair of related variables and a sign -plus or minus- depending if the relationship between them is positive or negative. A (+) sign near the head of the arrow is place if an increase (or decrease) in variable at the tail of an arrow caused a corresponding increase (or decrease) in a variable at the head of the arrow. If an increase in the causal variable caused a decrease in the affected variable, a negative (-) sign is placed near the head of the arrow. The analysis the dynamic behaviour of the system based on CLDs is conducted by identifying all feedback loops present in the system. Feedback loops can be reinforcing or balancing. Reinforcing loops reflect positive feedback systems. They can represent exponential growth or declining behaviour over time. Unlike re-

inforcing loops, balancing loops reflect negative feedback systems and seek stability or return to control (Sterman 2000). The interaction and interdependencies between these loops influence the overall dynamics behaviour of the system.

As suggested by the so called "extended learning loop" of Haraldsson and Sverdrup (2003) the modelling procedures occurs according the following sequence: (a) symptoms are discovered when dealing with the issue for the first time, (b) the problem definition emerges when the symptoms have been explained, the hidden causal structure behind it has been mapped and the feedback mechanism explained. The problem dimension is discovered; and (c) a specific question is addressed for the problem and system boundaries set around it.

The systems perspective has been used throughout all the research process; aiming at a holistic view of the problem and a thorough understanding of the issues at hand and the interdependencies between them. More concretely system dynamic techniques proved valuable first, in order to arrive to a clear problem diagnosis as suggested by Rose (1993) -presented in Chapter 3- and second, to support the development of a case study protocol.

Case study methodology

Yin (1994, 23) defines the case study research method as:

> An empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.

Case study research is most related with the field of sociology. In the United States the methodology was most closely associated with The University of Chicago Department of Sociology. From the early 1900s until 1935, The Chicago School was pre-eminent in the field and the source of a great deal of the literature (Tellis 1997).

Case study research strives towards a holistic understanding of cultural systems of action (Feagin et al. 1991) and therefore devotes extra attention to completeness in observation, reconstruction, and analysis of the cases under study (Zonabend 1992). As cultural systems of action refer to sets of interrelated activities engaged in by the actors in a social situation, case study research incorporates the views of the actors in the case under study; reason why they are considered multi-perspective analyses. These two features outline the competitive advantage of applying this methodology here. Other important features of case study research are. First, case study research is not sampling research, a statement put forward by main researchers in the field, including Yin, Stake, Feagin and others. Second, case study is a triangulated type of research strategy, which means that diverse protocols, using multiple sources of data, are used to ensure accuracy and alternative explanations. Such triangulation is in fact

needed to confirm the validity of the research process, given the limited amount of cases that make part of such a study.

Critical factors of success for a case study research are not only the selection of cases -so as to maximize what can be learned given the research project constraints- but also the selection of a unit of analysis and the definition of clear boundaries. The unit of analysis is typically a system of action rather than an individual or group of individuals (Tellis 1997). Case studies can be single or multiple-case designs. The selection of multiple cases must follow a replication rather than sampling logic. Yin (1994) pointed out that generalization of results, from either single or multiple designs, is made to theory and not to populations. Multiple cases strengthen the results by replicating the pattern-matching, thus increasing confidence in the robustness of the theory.

A way to make these factors operational is by developing a so called case study protocol. Yin (1994) recommended the use of case-study protocol as part of a carefully designed research project that would include the following sections: overview of the project (project objectives and case study issues), field procedures (credentials and access to sites), questions (specific questions that the investigator must keep in mind during data collection) and a guide for the report (outline, format for the narrative) (Yin 1994, 64). Essential elements of the case study protocol developed are presented in Section 2.5.3.

Given that the primary goal of the research is to draw lessons from international practices in administration and procurement of road infrastructure and therefore it requires deep understanding about the system where these innovative practices take place, and all its aspects and relationships; case study research methodology seems the most suitable option. This methodology will allow the analysis of the research objects, in this case national road administration practices, along various avenues and in a more qualitative way.

Stakeholder analysis

Stakeholder analysis is a methodology used often in processes of institutional reform to systematically gather and analyse qualitative information to determine the interests or needs of those who have a "stake" in the reforms (policies or programs) under consideration (Schmeer 1999). By taking into account the needs or the position of all these different actors, reform advocates could decide best on how to accommodate these interests in their proposal and in this way increase the likelihood that the policies adopted are politically realistic and sustainable.

Even though this methodology finds it origin in the business sciences, it has developed into a field that nowadays incorporates economics, political science, game and decision theory, and environmental sciences[10]. Freeman's (1984) book "Strategic Management: A Stakeholder Approach" in considered by most researchers in the

[10] http://go.worldbank.org/40BSM5Z9B0

stakeholders field as a landmark in stakeholder literature. In his book he defines stakeholders as "any group or individual who can affect or is affected by the achievement of the firm's objectives" (Freeman 1984, 25). An alternative definition more applicable to a reform process is offered by Schmeer (1999) who defines stakeholders of a particular process as all actors with a vested interest in the policy being promoted.

Stakeholder Analysis takes account of the following stakeholder characteristics: position in favour or against the policy, level of influence (power) they hold (Freeman 1984, Grimble and Wellard 1996), level of interest they have in the specific reform been studied and potential alliances or coalitions to which they already belong or can reasonably be associated with (Freeman and Gilbert 1987). These attributes are identified through various data collection methods, including interviews with country experts knowledgeable about stakeholders or with the actual stakeholders directly.

By systematically analyzing these attributes one would not only estimate the capability of the different stakeholders to block or promote the reform, but also acquire an idea of the impact of the proposed policy or reform on political and social forces, recognize conflicting viewpoints and therefore gain awareness about potential struggles among groups and individuals. All these aspects are expected to facilitate the process of searching and understanding the mechanisms behind the evolution of institutions. Satisfaction or dissatisfaction of different stakeholders with the status quo (or the new equilibrium after implementation of a certain reform) may be a good indicator of the stability of such equilibrium in the long-term and/or the inertia in the system.

An additional interesting aspect for such analysis is the notion of dynamics of stakeholders, which recognize that the mix of stakeholders may change over time. This concept was already acknowledged by Freeman (1984) who not only affirms that in reality stakeholders change over time, but also that their stakes change depending on the strategic issue under consideration. Recent authors contributing to further understanding of the concept are Alkhafaji (1989) and Mitchell et al. (1997).

Gaming-simulation

In the last decades many decision techniques to aid planning and management in large organizations have been developed. As Duke and Geurts (2004) explain, within these techniques there are two major styles. One set of these techniques has its history in applied mathematics, econometrics, operation research, and systems analysis. This set focuses on the use of formal models and algorithms for policy development and is most effective when dealing with problems that are more rational and calibrated, where few variables are crucial and there is a single decision maker. The second set refers to the so called "judgmental" techniques. They originate from disciplines like cognitive and social psychology and focus therefore on intuition, creativity, discussion and communication as stepping stones to strategic policy formulation.

Both sets have their limitations and advantages depending on the kind of problems under study. Gaming-simulation could be considered a hybrid form of these two sets.

Duke and Geurts (2004) state that an optimal approach to strategic planning formulation "should try to combine the best of these two approaches". In gaming-simulation reality is simulated through the interaction of role players using non-formal symbols with formal, computerized sub-models (where necessary).

The distinctive combination between non-formal symbols and computerized sub-models makes gaming-simulation the most suitable technique to research on the long-term effects of innovative contracting practices in terms of network condition and other market related criteria; in the absence of statistical or historical data and given the need to include soft variables in the simulation such as opportunistic behaviour, which are the product of human (semi) random decisions.

Important to clarify is that the main purpose of these games is not prediction but communication and the creation of insights about possible futures. In the creation of insights about possible futures -more specifically on contracting practices in the road sector- is where the contribution of this methodology to the research lies.

2.5.3 Case study design

In order to answer the research question a choice has been made for case study research techniques with a strong component of field research and qualitative interviewing techniques. This section presents a summary of the case study protocol developed and implemented in the three countries selected; Finland, Spain and the Netherlands. More detailed information can be found in Annex A and B.

Data collection for case studies

As mentioned previously most of the information has been gathered through interviews. The study has been designed as a multiple case study research with embedded units of analysis. The main unit is the national -or regional if deemed important- procurement strategy (NPS) with all its components (i.e. contractor selection methods, project delivery, project finance and performance contracting between others). The embedded units are particular projects, preferably Public Private Partnerships (PPP) projects in which these new contracting practices are being used.

Table 2.2 shows the main questions to be asked for each case. The relationship between these questions and the research questions for the comparative study is shown in the second column (research concept). As observed in this table, some of the concepts such as design freedom -as determined mainly by the level of performance indicators used in the contract- and enforcement mechanisms are studied in depth within a particular project, the embedded unit.

Organization of field research

Table 2.3 presents an overview of the field research realized in the three countries selected. As it has been mentioned before since the Spanish model is characterized by a

Table 2.2: *Case study questions per country*

Case study question	Research concept	Unit
What type of procurement model do they have?	Procurement strategies	NPS
How did this model evolve?	Drivers of change	NPS
Who are the actors?	Players and their behaviour	NPS/ project
What are the rules connecting them and how things actually work? Characteristics of each institutional context, formal and informal institutions.	Institutional structures and context	NPS/ project
What are the results of the new contracting practices?	Service levels and public values	NPS/ project
What is in the contract? (i.e. project delivery model used, Design Freedom and Innovation)	Design freedom	Project
What are the key Performance Indicators? What are the real decisive ones to calculate the reward of the contractor? (Other performance criteria are the in legislation and/or decides in process before)	Design freedom and enforcement mechanisms	Project
What performance indicators does the agency use - but are not used for rewarding? (valuation) or do they use them in the learning process	Design freedom and enforcement mechanisms	Project
How is information provided along the project - on how the actual work construction/maintenance is done? (spot checking) How do they supervise/check? (The contractor informs them or they check themselves)	Enforcement mechanisms	Project
What strategies did they have to combat the negative effects of information asymmetry? - Or of being misinformed?	Enforcement mechanisms	Project
Also in general: how communication between them goes? (Learning experiences and how do they review their reward/ delusion strategies)	Enforcement mechanisms	Project

high level decentralization, a slightly different approach was followed in the field research conducted in Spain versus Finland and the Netherlands. The study of the Spanish case included an extra unit of analysis, the autonomous community of the Basque Country, more specifically the Foral Deputation of San Sebastián. Nevertheless as interviews were also realized in Madrid -with national authorities like Ministerio de Fomento and large national contractors and consultancy companies- to double check the tendencies observed in San Sebastián, it is possible to present a fairly unified analysis of the Spanish procurement model. Specific differences recorded between the national and the regional situations are presented in Chapter 4. A detailed list of the people interviewed per country and their profile is presented in Appendix C.

Table 2.3: *Overview of the field research realized in the three selected countries*

Aspect	Finland	Spain	The Netherlands
Unit and Road Authority researched	National procurement strategy (Finnish Road Administration)	National (Ministerio de Fomento) and Autonomous Community (Gipuzkoa Deputation in San Sebastián, Basque Country)	National (Rijkswaterstaat)
Projects	DBFM project E-18	Rehabilitation and maintenance concession A-2	DBFM project Second Coentunnel
People interviewed	13 interviews and 2 sessions with periodic maintenance experts	6 Interviews in Gipuzkoa 4 Interviews Central Level	12 interviews and frequent email inquiries with different experts
Field research duration and date	6 weeks (March-April 2006) and 2 weeks (November 2006)	6 weeks (May-June 2007)	Continuous research but 2 concentrated efforts in 2006 and again in 2008
Validation	Finnish Road Administration mini-seminar (November 2006) where findings where presented and discussed with different stakeholders and two experts that read and revise reports	Desk research of other documents and publications in Spanish	Four meetings of the Council of Practice of the project where findings are and analysis of the research are continuously discussed
Other sources (than interviews)	Few written contracts translated to English	Contracts used in the different markets and by different road authorities (in Spanish)	Official presentations of Dutch Road Agency and other policy documents (in Dutch) Information like contracts and the like were hard to have access to

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Chapter 3

Conceptualization of the road procurement system

Parts of this chapter have been published in: Altamirano et al. (2007), Altamirano and Herder (2006), Altamirano (2006).

3.1 Introduction

Now that the research design, including the conceptual framework and the research strategy, has been presented in Chapter 2; this chapter dwells on the conceptualization of the Road Procurement System.

First, a summary of the practitioners' literature, an overview of the key issues in the specific area of public procurement of (road) infrastructure is presented. This overview derives from a preliminary research phase consisting of desk research and review of practitioners' literature in the subject and a first round of general interviews with experts and practitioners in the field. Practitioners' literature includes Delivery and Financing of Road Infrastructures, Innovative Road Contracting Practices and Performance Contracting.

Second, in order to arrive to an accurate problem diagnosis, a formal analysis of innovative contracts in terms of agency theory and engineering design theory is realized. The findings from the initial desk research and round of interviews are systemically organized by carrying out an analysis of the system in question. Interdependencies between the trends perceived in innovative contracting and their effects on system performance are illustrated through a succession of CLDs; with causal links deriving from the theories mentioned.

Third, an illustration of the many trade-offs and decisions that are nowadays realized by public infrastructure operators and which may be transferred to private con-

tractors if innovative contracting practices become the norm is presented. In order to do so, system analysis and system dynamics techniques are applied to the technical specificities of the road infrastructure system, the issue of road network condition and the impact of different maintenance activities.

The insights and understanding developed in this chapter form the basis, together with the conceptual framework presented in Chapter 2, of the case study protocol applied in the benchmarking study and of the gaming-simulation developed and presented in Chapter 6.

3.2 Public procurement of infrastructures

Significant changes have been recorded in the public sector in the last decades. Since the late 80s and 90s a new paradigm in public administration has emerged with the so-called New Public Management (NPM) model for the management of public institutions. NPM refers to a group of notions that prescribe a new way of operation for the public sector. The goal of this new administrative approach is to improve the performance of the public sector by paying special attention to accountability and flexibility in government practices and procedures and by reducing the role of the government.

NPM emerged as a reaction to the many flaws discovered in the traditional model (e.g. aggregate problem of financing, oversized government institutions, poor public service delivery and poor performance of public agencies) and under the influence of various managerial and economic theoretical schools such as agency theory, transaction costs economics and public choice theory. The latter has been particularly influential as it marked the beginning of inquiring the validity of the role fulfilled by the public sector up to then (Lemieux 2004).

Public Choice Theory (Buchanan and Tullock 1962) is based on the presumption of the inefficiency of the public sector and the need to reduce its role. A concept that plays an important role in the logic behind this drive to reduce the role of government is that of regulatory capture. Regulatory capture is a term used to refer to situations in which a state regulatory agency created to act in the public interest instead acts in favor of the commercial or special interests that dominate in the industry or sector it is charged with regulating.

Regulatory capture theory is a core focus of the branch of public choice referred to as the economics of regulation; economists in this specialty are critical of conceptualizations of governmental regulatory intervention as being motivated to protect public good.

Therefore, the regulatory capture model is the one that come closest to reflecting a Public Choice interpretation of administrative guidance and perhaps the most clear agency-theoretic approach to regulatory capture is that of Laffont and Tirole (1993). The following excerpt from "A theory of incentives in procurement and regulation"

by Laffont and Tirole (1993) offers a well formulated synopsis of the society drivers behind such a reforming wave:

> During the 1970s and 1980s we witnessed a renewed interest in the regulation of natural monopolies and oligopolies. In the policy arena discontent was expressed with the price, quality and cost performance of regulated firms and government contractors. The remedies sought in specific industries differed remarkably: More powerful incentives schemes were proposed and implemented, deregulation was encouraged to free up competition and entry, and in some countries changes in ownership (privatization) occurred (Laffont and Tirole 1993).

All in all, NPM as new administrative paradigm has motivated a shift to greater competition in the public sector and therefore a global trend of liberalization and privatization of public utilities, including road infrastructures.

Roads are technologically and institutionally less complex than other infrastructure types. Rolling stock consists of buses, lorries, taxis and private cars -all of which are owned by others than the infrastructure manager. Neither is the underlying technology for producing asphalt, maintaining it properly, eliminating ice, snow and other disturbing elements from the road surface exceedingly complicated. And yet road reform is, in the context of growing car use and congestion, budgetary restrictions, environmental considerations and lacking technological innovation in the past decades, a subject to be reckoned with.

For roads, entering in the age of this new paradigm has meant in most cases important structural reforms of many public road authorities around the world, which implied that their role changed from direct providers of the infrastructure to client organizations responsible for tendering all phases of road construction and maintenance activities (PIARC 1995, Talvitie 1996, Parkman 1998, Talvitie 1999). This process of moving from an in-house organization to a client organization is often referred to as the privatization process of a governmental agency (Madelin and Parkman 1999, Pakkala 2002). The phases of this process and alternative reform options will be presented in greater detail in Chapter 5.

Road reform is only a first stage towards the implementation of the principles of NPM, which stresses that private involvement enhances efficiency and effectiveness of public services. This first stage lays out an institutional framework for the commercial management of roads. It addresses the question whether services should be in house or to be bought, but things do not stop there. Once the decision is made to outsource all works, the question remains how to organize these work packages and outsource them in the most efficient way. Here the tendency is to use innovative contracts that transfer more risks to the private sector and to change the transaction from buying of a product into one of signing a service agreement.

It is important to clarify that a structural reform of the public road authority is not a necessary step for the introduction of innovative contracting practices. Many road

authorities around the world are implementing such innovative contracts without having experienced a clear reorganization; and even when they still perform many of the operation and maintenance tasks in-house.

3.2.1 Management of road infrastructure assets

The term infrastructure is used in a broad sense to refer to a collection of assets or public works as an unified system. Capital facilities such as buildings, factories and other engineering structures aiming to either provide shelter, transportation of people, goods, and information and/or other public services like water or energy These physical systems are considered essential for enabling productivity in the economy; and developing them often requires large initial investments.

There are a number of common elements to the management of infrastructure assets or infrastructure systems. These common elements are four: capital planning, initial delivery, in-service operations and maintenance and finally, once an infrastructure has reached its maximum useful life; capital replacement or decommissioning. However all of them are interrelated and each of them relies on a fifth factor; a competitive procurement process (Miller 2000).

Capital planning is considered the most important element of infrastructure management. Some of the key elements of this planning function include decisions about: size, function, and location of infra facilities; level of service (e.g. performance indicators and functional requirements), and nature of infra services to be provided; condition assessments of existing facilities and services; acquisition or rights of way, permits (to build, develop, operate); financial planning for initial capital development of facilities; and financial planning for continued operations and facility rehabilitation, replacement, and renewal. This is an iterative process that must incorporate input from the political process and that often is influenced by elections at al levels. In response to these external requirements public officials explore a variety of alternative capital programming scenarios which after negotiations will results in a long term infrastructure expansion plan, often called Infrastructure Investments Program. This long-term plan fixes a number of priorities in term of specific infrastructure projects.

Meanwhile, initial delivery or delivery of a new infrastructure (project) includes three main phases; engineering and architectural design, technology evaluation (including system or equipment selection) and construction. These phases could be performed separately or grouped, a decision that relates to the project delivery method adopted. The design phase includes subtasks like development of drawings and other descriptions of a facility and acquiring approval of licensed architects or registered engineers.

The in-service operations and maintenance element is in fact the most important one in terms of total life cycle costs on an infrastructure (60 to 90%). Nevertheless this portion of costs has been historically treated differently or separately from the initial cost of design and construction.

Finally, the capital replacement or decommissioning element which often involves rehabilitation of an infrastructure is rather difficult to differentiate from green-field construction. For this reason, large rehabilitation projects are often considered by taxation laws as capital expenditures, given the length of the service expected from this investment.

As stated before, all these elements depend on or are influenced by the choices made by the responsible authority concerning the procurement process. The following sections will present an overview of these different choices in the NPM setting. In concrete terms these choices refer to: (a) how the portfolio of projects is managed (tools), (b) alternative project delivery and project financing methods (initial delivery) and (c) alternative contracting methods for operation and maintenance.

3.2.2 A new approach for the management of infrastructures

There are a number of actors directly or indirectly involved in the task of providing infrastructure and on the decision making the management of infrastructure involves. The roles of these actors vary in a wide spectrum from taxpayers and voters to employees and entrepreneurs active in the sector. Three play a particularly important role. Procurement officials, which are daily in charge of the decision making at different levels, national, state and local levels; producers of infrastructures which includes designers, architects, builders, equipment manufacturers, system integrators, suppliers, financial institutions and combinations thereof; and last but not least, clients, which demand faster, better and cheaper services.

Part of the external environment of infrastructure management, are political bodies and elected officials which may or may not support the implementation of new procurement practices based on their trust that such practices will bring about improvement in terms of quality, level of services, cost performance and timeliness. Given the change in public administration practices that has lead to further professionalization of the public bodies, today public infrastructure managers face a very practical question: *How to configure portfolios of infrastructure projects so that different mixes of projects, delivery methods, and financing approaches can be evaluated to positively change portfolio quality, revenues, expense and technology?* (Miller 2000). This question is in fact the operational equivalent to the public concern of political bodies and elected officials.

Drivers for change in both public and private sector delivery mechanisms

Public infrastructure managers have come to realize the importance of a more professional and efficient management of their portfolio of capital assets and future projects, specially in the context of today marked by (expected) chronic deficit in capital budgets and the belief that the application of information technology applications has great potential to improve quality and reduce costs (Pietroforte and Miller 2002).

Both factors in combination with the principles of New Public Management - which stresses that private involvement enhance efficiency and effectiveness of public services- pose an urgent question to procurement authorities: How to attract private sector capital and expertise to the delivery of public infrastructure project and/or to the management of public infrastructure assets?

In this search for improvement, there are three concepts that seem to have gained importance in the decision making process at the portfolio level (Miller 2000, Koppinen and Lahdenperä 2004), these are:

- Environmental sustainability: long term environmental sustainability is unlikely to be evaluated on a project basis, rather on a portfolio basis.
- Technological innovation: moving from "dumb" individual facilities to "smart" network systems, and multiple information services are expected to improve quality, provide new services and lower costs.
- Value for money: this third driver is based on the perception that government has failed to deliver public goods effectively (influenced by NPM).

Essentials of the new approach

The new approach capitalizes on the differences between public authorities (clients) and private contractors (producers) by recognizing that each can contribute in ways that are amenable to their inherent strengths.

There is a common conception among professionals on both sides that public authorities are better able to identify needs, align economic and infrastructure strategies, create government commitment to viable projects and delivery processes in the public sector, set up reliable commitments for infrastructure financing, impose and manage market externalities such as permitting and environmental protection and provide a fair competitive environment for contractors participating in the sector. Meanwhile, private infrastructure producers are considered best at contributing efficient (technical) competencies -sharpened through their participation in competitive markets-, providing independent checks of the technical and economic viability of projects and providing alternative sources of financing for projects that are potentially self sufficient.

The new approach marks a shift away from downstream procurement process activities (resembling more work orders) toward upstream ones, which translate in a better balancing or coordination of the different public infrastructure manager responsibilities (i.e. pre-construction and construction functions). In contractual terms the new approach translates into a tendency to transfer more risks to private contractors; a new accent on how different project risks are shared between both partners according to their competences. The motto is "assign the risk to the one best able to carry it".

3.2.3 Public procurement tasks

The public obligation of procuring infrastructure, in this specific case a road network, can be divided into four different kinds of tasks along which most public road authorities have organized their procurement strategies and markets. These are; a) capital projects which means the construction of green field projects or new roads, b) routine maintenance of the existing road network, which includes daily activities that ensure the continuous availability of the road -these are mainly superficial like roadway and shoulder maintenance (include pothole patching, crack filling), drainage, roadside vegetation maintenance, and winter maintenance- and c) periodic maintenance of the same network, which refers to the management of pavements and the planning of activities required to return the state of the road to its original condition by repairing road damage and thereby substantially altering the asset condition. The following activities can be included in extraordinary maintenance: pavement strengthening, resurfacing, in-situ recycling, road mixing, and rehabilitation of existing pavements; d) operation of roads, which mainly includes incidental traffic and safety services.

Given their relative importance based on the levels of outsourcing for each of them and whether they require different expertise or disciplines; a common division of the markets in the road sector only includes capital projects, routine maintenance and periodic maintenance. These tasks coincide with the common phases of an infrastructure project: design, construction, in-service operation and maintenance; and replacement. The out-sourcing or tendering of these different phases for an infrastructure project could be done in a segmented or in a combined or integrated way. The degree of integration is a consistent way to distinguish alternative project delivery strategies. This and other options about the delivery and financing method to be chosen for a particular infrastructure project compose the key variables that define the procurement strategy or procurement process of a road authority. The different options available will be presented in the following sections.

Managing a portfolio of capital projects

The first challenge when aiming at a competitive procurement process for an agency is to decide how to manage the varied portfolio of future capital projects and in which way these different projects should be tendered out. There are currently several methods available to public agencies for delivering transportation projects. The challenge is not only to choose the best method but having various methods at the agency's disposal that fit the project and deliver value (Alhazmi and McCaffer 2000).

The work of Alhazmi and McCaffer (2000), Miller et al. (2000), and many other recent works (Koppinen and Lahdenperä 2004, Molenaar and Yakowenko 2006) support the notion that there should be no "standard" project delivery or project financing method used but that the agency should keep a variety of methods and chooses the appropriate one on a project basis. In his view, although there are too many alternative schemes to deliver public infrastructures, "one-of-a-kind" procurement has become

the routine. They propose a number of tools to assist decision makers in this decision proces.

The quadrant method

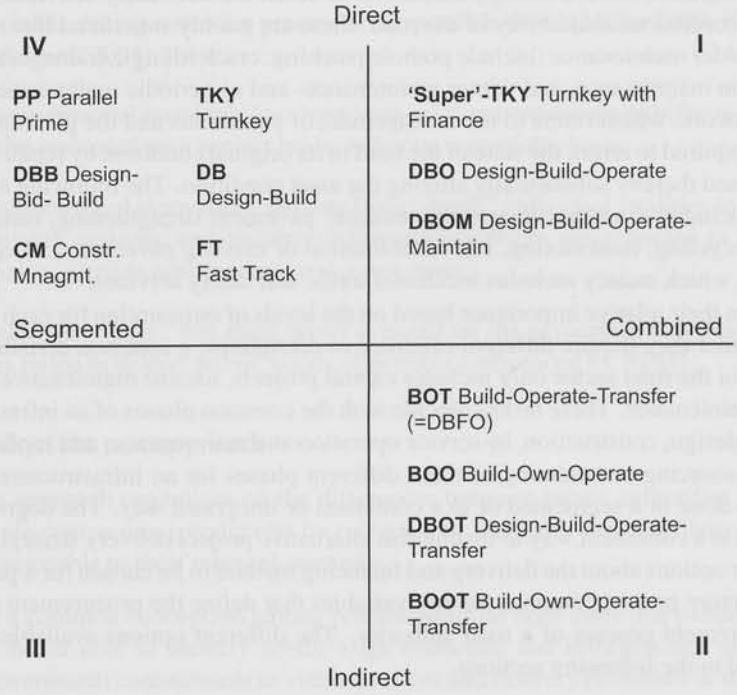


Figure 3.1: *The quadrant framework*

There are two main variables that define the spectrum contract types of possible for the delivery of a (new) infrastructure project. The first, degree of integration, corresponds with the project delivery method chosen and the second, source of finance or project cash, with the project financing method.

The quadrant method (Miller 2000), presented in Figure 3.1, is a combination of both variables and allows a clear and easy representation of all possible options. The degree of integration is the degree to which typical project elements (planning, design, construction, operations) are separated from each other, it refers to whether one or more life cycle phases of the infrastructure are part of the project are being tendered out. The source of finance measures the degree to which government assumes the direct financial risk for producing the project; the source of project cash distinguishes

between direct and indirect finance. When a project is financed directly by the owner -in this case the government- applies its own cash resources to finance the project; while if the choice is for indirect financing, an owner (government) structures the project so that the developer or contractor provide its own cash resources. In practice projects may be financed through combinations of direct and indirect means.

Accordingly, the vertical axis depicts a strategic choice by the government to arrange project funding somewhere between two fundamentally different options: (a) to "push" specific projects "directly" through current cash appropriations, or (b) to "pull" specific projects "indirectly" through incentives, mandates, dedicated income streams, or other measures, which encourage the private sector to finance government goals.

The horizontal axis represents a strategic choice to approach project delivery in two different ways: either by clearly separating each of these different steps in the procurement process from another (so-called a "segmented" process); or by combining all these aspects of an infrastructure into a single procurement of the completed facility (a "combined" process). As it will be explained later in greater detail, either choice, to combine or to clearly separate the different phases has its own advantages and disadvantages. In general, the combination of different phases could result in shorter delivery times and lower life cycle costs (LCC), but it also reduces the control of the public client over the process.

Accordingly, Quadrant I is defined by combined project delivery methods directly financed by the government; Quadrant II is defined by combined (integrated) project delivery methods indirectly financed; Quadrant III by segmented project delivery methods indirectly financed -which are generally unused-; and Quadrant IV by segmented project delivery methods financed directly.

Discounted cash flow

A second tool for managing the portfolio of projects is the discounted cash flow. This tool calculates per project the sources and uses of cash along the years and their Net Present Value (NPV). Understanding the overall costs of a facility is the first step towards efficient management. In fact, without understanding current actual costs, by activity, it is not possible to correctly assess the incremental effect -positive, negative, or neutral- of any new project on the overall cost of a facility. Such knowledge is a necessary condition to efficiently manage a collection of facilities.

The calculation of the NPV requires the estimation of incremental revenues and incremental costs and contributes to a clear picture of the effects of the choice of a particular project delivery method on the future costs and quality of the facility. It explicitly introduces the opportunity cost of capital, the impact of the constant evolution of technology and uncertainty.

Uncertainty of the flows is a key factor that needs to be taken into account; initial cost, operating costs, periodic revenues, and construction schedules are only "esti-

mates" given the changing external environment and the rapid pace of technological changes.

Until recently most infrastructure owners or administrators modeled only cash flows during initial delivery, which is the easiest part as they are typically fixed by the project contract but ignores the cost of operation and routine maintenance, which may represent up to 90% of the total life cycle costs.

Different cash flows for each delivery method

In practice the cash flows of a facility differ depending on the project delivery method being considered. The amounts and the timing of such flows may differ greatly depending on whether the project is delivered using BOT, DBB, DB or DBFO. By recognizing and calculating these differences in flows, the simultaneous use of multiple project delivery and finance methods also contributes to improving the management of portfolios of infrastructure assets. For an overview of the differences in present costs (PCs) of different project delivery methods, based on the application of the discounted cash flow method, see the work of Lahdenperä (2008).

The application of this tool points towards an emerging problem. In order to efficiently operate the portfolio of infrastructure assets, understanding three key elements is a necessary condition; the costs of current activities, the current condition of the assets and project delivery methods available.

Obstacles for a long-term portfolio planning

As mentioned before, managing a portfolio of assets involves two key concepts: condition assessment (i.e., what repairs will be required and when in order to keeps the asset functioning properly) and activity based costs (i.e., what are the costs of operations and maintenance -historically, currently and in the future). Three common obstacles are found in the old practices in infrastructure management and public procurement (Miller 2000):

(1) Total costs are collected, but not by activity. Often road authorities and other public authorities around the world cannot track life cycle costs of any of the facilities in its collection (Lahdenperä 2008) -an important prerequisite for long-term capital program decisions.

(2) The condition of infrastructure assets is largely unknown, unmonitored, and unreported. Infrastructure condition is simply not a key element in the capital program methodology. Incremental capital budgeting is the common practice.

(3) Current and future repairs obligations are largely invisible. Repair obligations are "projects" too, but, because they are invisible in the capital programming process, they don't compete with other capital projects for limited resources.

Without such objective measures, clients choosing for one or another project delivery method can in fact only guess about the improvements they bring.

3.2.4 Alternative project delivery methods

A project delivery method is a term used to explain all the contractual relations, roles and responsibilities of parties involved in (capital) project delivery (Ghavamifa and Touran 2008). It refers to the organizational framework of a project that defines the control mechanisms and the relationships between actors and their incentives (Lahdenperä 2008). Different project delivery systems simply provide different ways of packaging the procurement process. Each system adds new characters to the traditional participants, including the client, the designer and the builder, and the characters' roles expand depending on the system used (Loforte Ribeiro 2001).

Many different options within a spectrum are available for the delivery of a project, some of them are: sequential Design-Bid-Build (DBB), Design-Build (DB), Parallel Prime, Fast Track, Construction Management (at risk), Construction Management (not at risk), Turnkey, Design-Build-Operate (DBO), Build-Operate-Transfer (BOT), Design-Build-Finance-Operate (DBFO) and Build-Own-Operate (BOO). For a definition of a number of these terms see the glossary of terms.

There are also different formats for financing an infrastructure project. The continuum of approaches applied to infrastructure project finance by public and private owners, quasi-public agencies, developers, constructors, financiers, bankers, investment bankers, and fund managers includes: complex combinations public and private sector debt and equity, sovereign obligations, commitments, statutes, and regulations and other incentives along with private sector guarantees.

Five key project delivery alternatives

Choices for project delivery and finance are at the basis of the emerging procurement strategies of public infrastructure providers. In spite of the variety in formats available, there seem to be a limited number of procurement strategies adopted by public authorities; (a) separately outsourcing of pure Operations and Management (O&M), (b) Design-Bid-Build (DBB), segmented and publicly financed, (c) Design-Build (DB) segmented and publicly financed, (d) Design-Build-Operate (DBO) publicly financed and (e) Design-Build-Finance-Operate (DBFO) which makes use of private financing. The main alternative methods are discussed in the following section.

Design-Bid-Build

As shown in Figure 3.2 below, in a DBB contract the client or public authority remains responsible for the financing of all functions and activities throughout the process. DBB is the traditional delivery method chosen by public road authorities and is still

the prominent one in most countries (Koppinen and Lahdenperä 2004); (Pakkala et al. 2007).

Under the traditional DBB procurement strategy, the owner contracts separately with a designer and a contractor; which requires design completion prior to procuringconstruction. The winner contractor is typically selected based on the lowest bid price and agrees with the owner to construct the road in accordance with the provided plans or drawings (Koppinen and Lahdenperä 2004). Periodic maintenance is commissionedseparately or performed in-house.

Figure 3.2: *DBB division of responsibilities*

Main reasons for the prevalence of this method are that it offers the opportunity to keep considerable (quality) control of the process while minimizing the workload of internal project staff by capitalizing on the expertise of a variety of external engineering professionals (Antoine 2002). The client feels more in control as this method allows him to review the design prior to advertising the work for construction and provides him with clear documentation upon which to evaluate and assess the contractor's performance prior to payment. Nevertheless,this methods has also received criticisms stemming from long delivery times, excessive cost growth, and litigious relationships (Molenaar and Yakowenko 2006).

Design-Build

The main difference between DBB and DB is that both, design and construction of the facility are contracted out from a single contractor, instead of separately from a design professional and a contractor. The key reason to opt for the use of DB over sequential DBB is time savings. Besides as a single entity -combining two different types of expertise- is responsible for the whole process, it is also expected to result in cost savings (Koppinen and Lahdenperä 2004) and technological innovations. Accordingly, competition between design-builders is likely to shift from based purely on price to also include other evaluation criteria such as quality, time management and qualifications of the team (Molenaar et al. 1999).

Design-Build-Operate

Design-Build-Operate (DBO) also referred to as Build-Transfer-Operate (BTO) is a contracting scheme under which once the facility is completed, the title of the new facility is transferred to the public sector, while the private sector operates it for a specific period. As depicted in the Figure 3.3, the shift from DBB to DBO represents a significant leap from the segmented to the combined (integrated) axis in the quadrant framework and an equally important change in contracting philosophy.

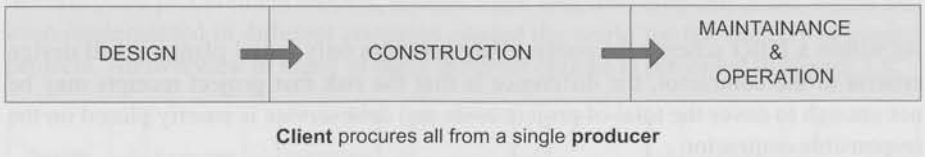


Figure 3.3: *DBO division of responsibilities*

Under such a contracting scheme the public client provides initial planning and design criteria, as well as sufficient financing for the producer to operate all the tasks he has been assigned. Payments could be provided using two main schemes; either direct cash payments from authority to contractor or equivalent amounts of cash provided that user charges are collected and the right to collect them is transferred to the contractor.

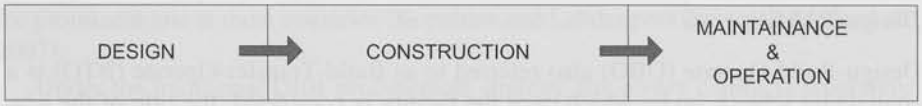
Some of the reported advantages of DBO over traditional segmented DBB schemes, include that projects can be delivered faster, having a single contact point government-contractor, and having built-in incentives to innovate in rapidly changing technological areas (Koppinen and Lahdenperä 2004).

In terms of design freedom or space granted to contractors, the "project brief"[1] of a DBO project frequently establishes not only minimum environmental standards and performance requirements, but also provides a range of "maximum flexibility" to proposers, within which to develop and suggest their own approaches to reach these minimum requirements.

Design-Build-Finance-Operate

Design-Build-Finance-Operate/Maintain (DBFO, DBFM or DBFO/M) is a combined and indirectly financed project delivery method, under which the private sector designs, builds, finances, operates and/or maintains a new facility under a long-term lease. At the end of the lease term, the facility is transferred to the public sector

[1] A project brief is a written explanation given to the designer which outlines the aims and objectives of a project. A thorough project brief helps to develop an understanding between client and designer/producer, while serving as an essential reference point for both parties - ensuring important design issues have been considered and questioned before any design or construction activity begins.



Client procures all from a single **producer**
(as an integrated whole and taking care of financing)

Figure 3.4: *DBFO division of responsibilities*

As within a DBO scheme the public client provides only initial planning and design criteria to the contractor, the difference is that the risk that project receipts may be not enough to cover the total of project costs and debt service is strictly placed on the responsible contractor.

Under a narrow definition of DBFO, DBO and a DBFO would differ in a fundamental way: DBFO cash flows are generated only from financial viability of the project itself (i.e. projected revenues) or from the financial strength of the private developer, and thus do not originate from the public client. DBFO in a strict sense should never include direct public subsidies in cash appropriations or equivalent. Such strict distinction is however not applicable to many DBFM schemes applied in Europe, specially when payments (from public authority) are based on "availability" of the road and not on user fees or toll charges directly collected by the private contractor; and therefore contractor in fact does not run with traffic or market demand related risks. In fact, there are currently diverse payment mechanisms in use, the main types are: availability payments, shadow tolls, real or direct tolls (heavy vehicles or all vehicles which transfer market risks to contractor) and performance-based payments (Pakkala et al. 2007).

Some of the key benefits expected from DBFO schemes over traditional DBB schemes are: time savings, private financing without revenue risk (AECOM Consult 2005, Pakkala et al. 2007), confirmation of project motivation by the private sector (through the additional role of financers), participation in innovations which reduce capital costs, and the opportunity to choose "best value" from various combinations of Design, Construct and Operations and Management activities and prices options (Miller 2000). In fact the role of the government under such schemes is expected to be limited to the identification of overall project requirements. In other words, such scheme stands for a lighter administrative burden, which is also consider a main advantage of it (Koppinen and Lahdenperä 2004) .

Pure Operations and Maintenance

As reflected by its name, pure Operations and Maintenance (O&M) is directed solely at providing O&M of an already existing infrastructure facility or service. Under such a scheme the public client outsources them to a single producer. The need for such a

scheme derives from the fact that two other project delivery methods -DBB and DB- do not include any of these activities in the contract. Consequently this method is the appropriate procurement method if a government has obtained a new facility through DBB or DB and/or decided not to operate and maintain this facility with in-house personnel.

Other innovative procurement models for capital projects

Several other procurement models, besides these five, are being discussed, tested and even implemented in different countries around the world for the delivery of capital projects. An overview of many of these different options is presented in Figure 3.5.

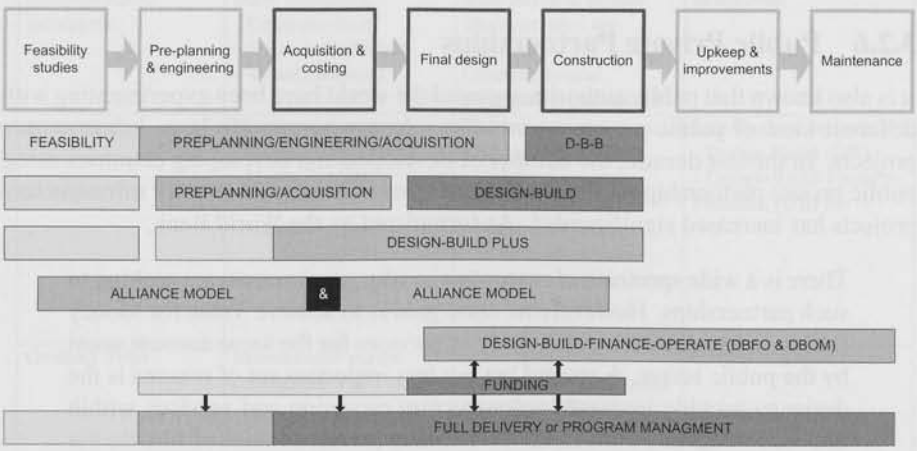


Figure 3.5: *Overview of main project delivery methods. Source: Finnra (2003)*

Besides this wide variety of project delivery methods, new infrastructure procurement practices have introduced a series of innovative concepts or methodologies such as: partnering, value engineering, construction reviews, incentives and disincentives built in contracts, performance specifications and multi-parameter bidding (A+B+Quality). For definitions go to glossary, and more information see Molenaar and Yakowenko (2006).

3.2.5 Trends in the three different infrastructure markets

All in all new procurement practices seem to be characterized by a number of elements or there seems to be a number of more important trends; combined or integrated contracts, a shift from technical requirements to functional or even performance specifications, indirect financing of projects, long term contracts and alternative awarding criteria besides price.

These practices are not applicable only to new capital projects but also to the maintenance of existing facilities. Nevertheless, these tendencies acquire a somewhat different shape and advance at a different pace depending on the market segment they are applied to; capital projects, routine maintenance or periodic maintenance; as depicted in Table 3.1. The differences stem from the particularities of each of these tasks been outsourced and the technical disciplines to which they relate. These differences should be taken into account during the analysis of the different national procurement strategies.

As can be seen in Table 3.1, private financing is only known in capital projects; maintenance in both forms, periodic or routine, seems to be always financed directly by the government.

3.2.6 Public Private Partnerships

It is also known that public authorities around the world have been experimenting with different kind of public-private partnership schemes to provide large infrastructure projects. In the last decade, the number of developed and developing countries using public private partnerships (PPPs) as the preferred financing scheme for infrastructure projects has increased significantly[2]. As formulated by the World Bank:

> There is a wide spectrum of reasons as to why governments are seeking to such partnerships. However, the main goal is to achieve Value for Money (VfM) and to deliver better quality of services for the same amount spent by the public sector. A second but not less important set of reasons is the desire to provide increased infrastructure provision and services within imposed budgetary constraints by utilizing private sources of finance via off balance sheet structures, and to accelerate delivery of projects which might otherwise have to be delayed (World Bank Website; World Bank Institute's online (WBI) Learning Programs, on the topic Public-Private Partnership in Infrastructure)

Different definitions for the term public-private-partnership have been formulated and adopted by different authors and public bodies. Two main interpretations of the term could be adopted, in a wider or a narrower sense.

In a wide sense a PPP could be defined as a "A cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards[3].". By adopting such a definition public-private partnerships would include a wide array of models that make increasing use of the expertise or capital of the private

[2] Source: `http://go.worldbank.org/E787QINP90`

[3] Definition embraced by the Canadian Council for Public Private Partnerships. Available at: `http://www.pppcouncil.ca/aboutPPPdefinition.asp`

Table 3.1: *Innovative contracting practices in three different road infrastructure markets*

Element / Dimension	Routine Maintenance	Periodic Maintenance	Capital Projects
Private Financing	Not yet known	Not yet known[a]	Used under different PPP schemes
Functional Specifications (more outcome based indicators)	More performance related than the rest. Main indicators: - Response time - Friction coefficient - Visual measures	No significant advance yet: tests being realized. Now physical-related characteristics are checked Certain physical condition is guaranteed	Advances is faster than in the rest: Availability of the road
Integration	Task/content wise: - Winter Maintenance - Minor Repairs Area wise: - Number of km	Task/content wise: - Bound structures - Unbound structures Area wise: - Number of bridges - More road sections Maintenance cycle wise: - Planning and/or - Programming	Life Cycle wise mainly: - Design-Build (DB) - Design-Build-Finance-Maintain (DBFM)
Contract Term	Maintenance period contracted: 3 to 7 years	Often immediate checking but term could be extended by: Condition responsibility for a certain period (5, 10 or 15 years)	Concession time: Construction plus Maintenance and Operation period
Contractor Selection Criteria[b]	75% Price 25% Quality	90 or 100% Price	70% Price 0% Quality
Payment	Lump sum: monthly service fee	Lump sum plus maximum percentage of unit prices	Lump sum for construction paid according to particular milestones plus monthly service fee for maintenance term

[a] Spain has recently started with new long-term rehabilitation contracts that extend the old concession model to already existing roads. For more details see Chapter 4.

[b] These percentages reflect the average practice in most countries, thus they are not to be understood in their absolute value.

sector. As shown in the Figure 3.6 at the one end there is contracting out of integrated processes (such as DB), while at the other end are projects still publicly administered but within a framework that allows for private finance, design, building, operation and possibly temporary ownership of an asset (such as a concession). Traditional segmented contracting, such as Design-Bid-Build, is not part of this spectrum.

In a narrow sense, the term PPP can be understood as comparable to the term "privatization" and referring actually just to the contracting schemes in the furthest point of the spectrum, where most or all assets are held by the private sector. This is often the meaning given to the term by American practitioners, and under European practitioners PPP often refers to DBFO or DBFM contracting schemes.

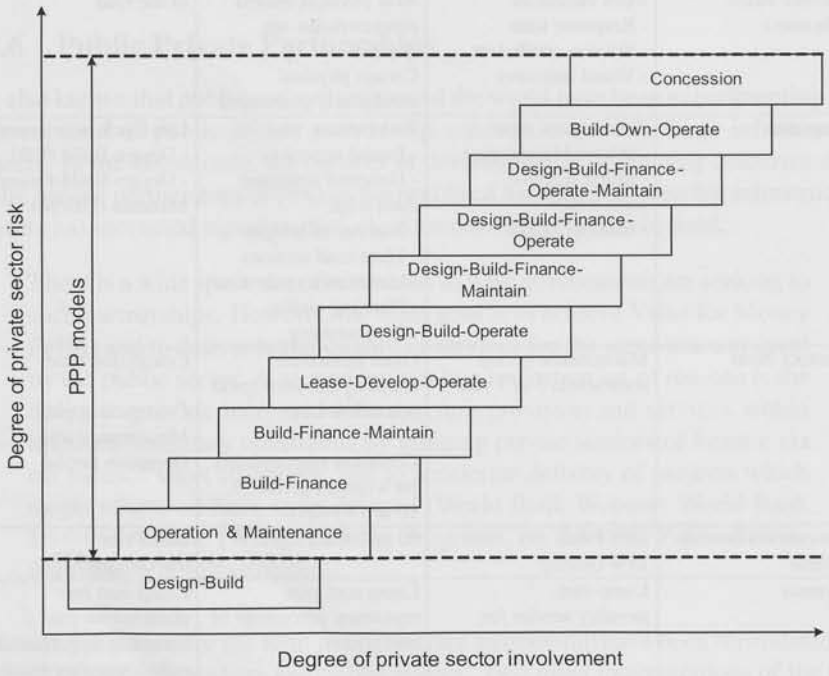


Figure 3.6: *Scale of public private partnerships (adapted from the Canadian Council for Public Private Partnership)*

Fundamental elements

Under any of the interpretations, a number of factors are required to ensure a successful implementation of such practices. Fundamental elements or principles that need to be incorporated to guarantee a stable public-private infrastructure strategy that

properly balances the interests of government, taxpayers, users and the industry are according to Miller (2000) transparency, openness to technological change, financial analyses over the whole project life cycle (Life Cycle Costing), and the restoration of a dual track strategy with projects financed directly and indirectly as justified by their nature.

First, transparency refers to the signaling towards potential competitors that they will receive a fair treatment. Competing contractors need to be able to see and understand the acquisition process -prior to making a commitment- and trust the impartial implementation of it. Transparency is even more important in the context of new multi-parameter bidding and head-to-head competition.

Secondly, openness to technological change is reflected in the implementation of strategies that permit and encourage the use of new technologies where proven technologies are also available and is operationalized by the concept of design space granted to contractors.

Thirdly, the application of financial analyses over the whole project life cycle means a shift in financial analysis from "initial delivery" to "life cycle", in which condition assessment and activity based costs provide a complete picture of present and future infrastructure requirements, and in which repair and maintenance projects compete with new projects for scarce public and private resources. A common denominator of such analyses is the application of discounted cash flow analysis over life cycle costs (DCF LCC) which allows for comparison of alternative project delivery and/or financing strategies. Managing only on the basis of initial design and construction costs is not sufficient to optimize the whole infrastructure portfolio.

Finally, the restoration of a dual track strategy -with the simultaneous use of public and private financing- aims at consistently integrating public and private sector technology, expertise, and financial resources.

Current obstacles in public procurement practices

Unfortunately as found by Miller (2000) in a number of case studies he conducted in the USA, there are a number of problematic patterns in the way governments - national and local- select prospect infrastructure projects, choose the project delivery and financing method and interact with the private sector in the common endeavour of providing infrastructure services. Some of these patterns and their consequences follow.

First, little commitment shown by the government towards particular projects -for which often no clear scope of work has been defined- which results in diminished private competition. Governments, taxpayers, and user cannot realistically rely on strong competition for projects to which the government has little commitment.

Second, infrastructure planning is still focused on the project level with little attention paid to the incremental effect of each project on the overall performance of the entire portfolio of assets. Without an approach that considers project and portfolio it

remains unrealistic to expect better quality and cost performance.

Third, the "anecdotal" use of project delivery methods in the Quadrant I and Quadrant II of the Quadrant Framework -meaning integrated and privately financed methods- results in tendering process that are extremely time consuming and very costly for the private sector. Transaction costs incurred by private firms in understanding and complying with widely different proposals requirements for each and every experimental use of such delivery methods is an important barrier towards their successful implementation. Such high transaction costs increase the costs of the facilities delivered and diminish competition as they represent barriers to entry to new firms. The costs of preparing a DBFO offer is significantly higher than the one of preparing a DBB or even a DB offer (Hughes et al. 2006).

3.2.7 Performance contracting

The main idea of performance-based contracting is to pay contractors based on results and not just on their best efforts. Performance contracting emphasizes objective, measurable performance requirements and quality standards while: developing statements of work; selecting contractors; determining contract type and incentives and performing contract administration.

The expected benefits of performance contracting stem from the fact that it allows the contractor to employ whatever means he considers are most appropriate (and economic) to satisfy the performance specifications provided by the owner. Consequently they are expected to allow innovation through creative design and construction methods -and are thought to lower the overall price of a given project (Cox et al. 2002).

Such a different contracting philosophy also requires the application of alternative awarding methods such as multi-parameter bidding which take into account and give proper weight to factors such as past performance and innovative solutions. As mentioned before to exploit their maximum potential this type of contracts involves the use of innovative payment mechanisms typically using end-product qualities as measurements.

Performance contracting is being applied in Europe as part of long term maintenance contracts, DB, DBFO and concessions contracts (Cox et al. 2002).

Performance specifications

A critical element of performance contracting are the so-called performance specifications (Cox et al. 2002, Cervera and Minchin 2003, Guo et al. 2005). Performance specifications detail both the operating level and minimum condition of the facility at the time it is returned to public ownership. Different countries have formulated different categories in accordance to their needs. For example, the Dutch Road Administration (Rijkswaterstaat) has defined performance specifications at five levels of requirements levels that go top to down from: road-user wishes, performance requirements, construction behaviour and materials behaviour to requirements for basic ma-

terials and processing. Most categories developed represent a continuous translation from the top down, where the top often refers to the set of public values that need to be safeguarded by the public authority (or strategic management indicators) and the lower levels match or are equivalent to technical specifications of materials and/or processes (See Figure 3.7).

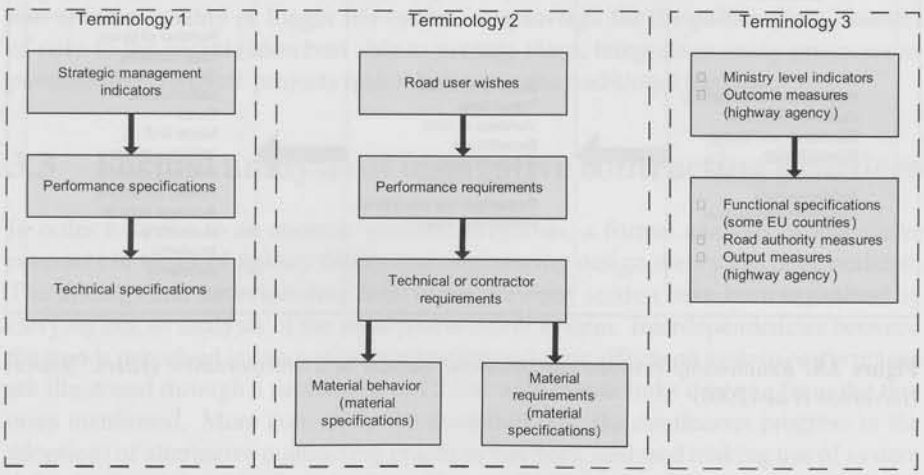


Figure 3.7: *Levels of performance indicators according to different terminologies*

In this way performance contracting is part of a wider shift towards a more systematic planning and accountability in transportation decisions; as it has been advocated by Halvorson et al. (2000). In their paper "Performance-based planning: asset management, and management systems" they provide an example of such translation process for the whole transportation sector -in the state of California, As presented in Figure 3.8, they clearly illustrate the relationship between outcomes and outputs in a multimodel transportation system.

The goals of the project under which this scheme was prepared were; (a) to develop indicators and measures to assess the performance of California's multimodal transportation system to support informed transportation decisions by transportation officials, operators, service providers and system users; and (b) to establish a coordinated and cooperative process for consistent performance measurement in California (Halvorson et al. 2000, 10).

Performance indicators

Performance specifications can only be applied effectively if the outcomes are measurable and verifiable (Cox et al. 2002). Each performance specification must match a set of performance indicators associated so that the road authority can measure and

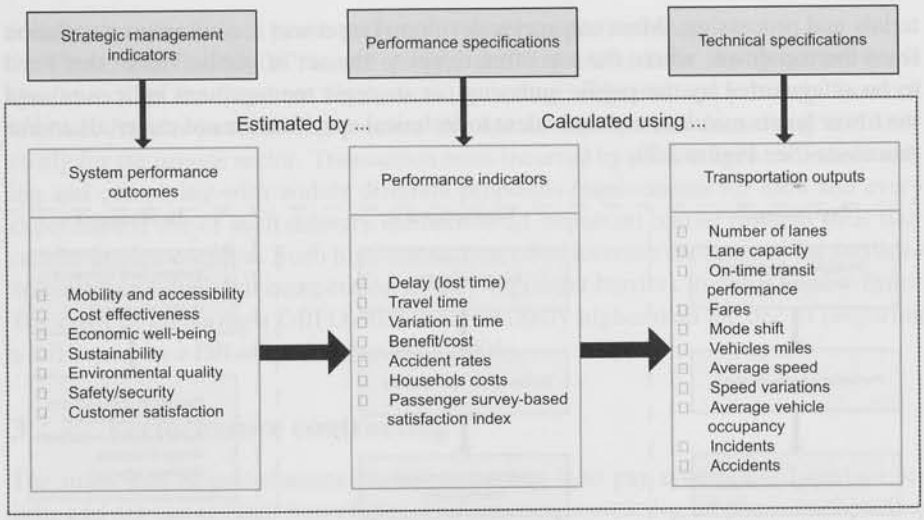


Figure 3.8: *Relationship between outcomes and outputs in a transportation system. Source: Halvorson et al. (2000)*

verify the quality and execution of the product. In essence, the road authority first formulates the performance specification and then inspects the performance via the performance indicators.

(Cox et al. 2002) provide a clear example of how this process works in the United Kingdom for maintenance (MAC) contracts. As presented in Figure 3.9, the method begins with the formulation of general performance requirements describing the desired outcome of the product from the owner. It then defines Key Performance Indicators (KPI), which describe the targets used to measure the performance requirements. These are further defined in terms of area performance indicators, which enable the specific targets to be set. Finally, the system provides a mechanism for setting the targets.

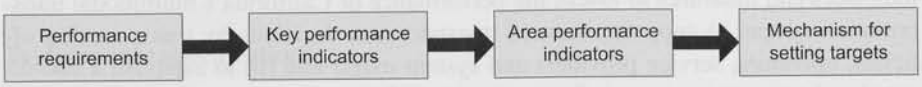


Figure 3.9: *Formulation process of performance indicators for MAC contracts. Source: Cox et al. (2002, 53)*

Summarizing, performance specifying is a complete change in direction from prescriptive specifying because the main objective of the road agency is to specify the performance level or outcome of the project and not the means and methods as to how that outcome is achieved (Cox et al. 2002). This new contracting approach also means

a change in the role of the public authority from service provider to network operator, in this case through the auditing system.

3.2.8 Summarizing: goals of innovative contracting

Independent of the market to which they are applied, innovative contracting methods aim at better quality or longer life cycles, cost-savings for the public client, transfer of risks to the organization best able to manage them, integrate as many processes as possible and complete projects faster than when the traditional method.

3.3 Formal analysis of innovative contracting practices

In order to arrive to an accurate problem diagnosis, a formal analysis of innovative contracts in terms of agency theory and engineering design theory has been realized. The findings and understanding built in the previous section have been organized by carrying out an analysis of the road procurement system. Interdependencies between the trends perceived in innovative contracting and their effects on system performance are illustrated through a succession of CLDs; with causal links deriving from the theories mentioned. More concretely the evolution (i.e. the continuous progress in the adoption) of alternative contracting practices has been analysed making use of system dynamics, in order to answer the following questions:

- What effects could we expect from these different trends?
- Does synergy exist between these different practices and therefore which practices and combinations thereof are likely to succeed?
- Does tension exist between the (technical) aspects of flexibility and those regarding public values?

System dynamics presents a fine opportunity to understand the evolution of these different trends because this technique allows the researcher to place the analysis in time and to represent phenomena of "increasing returns"; which makes the timing of the so-called "small events" (Arthur 1994) or historical events decisive for the final or evolutionary equilibria the system will reach. It is important to clarify that the analysis presented here is focused on the conceptual part of system dynamics, and therefore presented in terms of causal maps rather than of stocks and flows diagrams.

3.3.1 Agency theory and engineering design theory

Before presenting system diagrams with the analysis of the evolution of the different practices, we will present here the most important causal relationships in the model. These relationships together with their theoretical basis are presented in Table 3.2. The relationships not mentioned in this table come from the review of practitioners' literature on public procurement and from interviews with experts.

Table 3.2: *List of most important causal relationships*

Causal Relationship	Theory	Theoretical explanation
Output/effort based criteria → (-) design space	Design Theory	The more operational and detailed formulated the client requirements (for tendering) the smaller the design space left to the contractors bidding
Flexibility → (+) innovation	Design Theory	The more design space given to contractor, the more opportunities he has to innovate (in the design solutions he will propose)
In-house expertise → (-) information asymmetry	Agency Theory	Information asymmetry occurs when one party to a transaction has more or better information than the other party and is therefore equivalent to what Agency Theory calls "private information" (Lambert 2001) of the agent. If the government agency has less expertise and technical know-how, the "private information" of the agent increases.
Information asymmetry → (+) room for opportunistic behaviour	Agency Theory	Taking into account that the agent has an incentive to misreport the "signal" he saw in order to receive a more "favourable" compensation contract, if there is more information asymmetry and he has more "private information" he will have more opportunities to misreport without being noticed.
Outcome/final quality criteria → (+) Information asymmetry → (+) Room for opportunistic behaviour	Agency Theory	This is the result of various theoretical propositions: a) The sensitivity of the signal (performance measure) measures how much the expected value of the signal moves in response to a change in the agent's effort, b) Effort is costly to the agent and therefore he aims to minimize it. Assuming that the higher the level of performance indicator used, the more noise is introduced in the signal and this become more driven by other factors (i.e. external factor, etc) than agent's effort; then information about agent's effort become private information. Therefore outcome/final quality criteria are expected to give more opportunities to the agent to maximise his utility without increasing the real outcome and own effort level.
Combined/Integrated contracts → (+) Room for opportunistic behaviour	Agency Theory	Given that not all performance measures are equally sensitive to a particular action, some can be more easily manipulated than others. When the agent is responsible for multiple tasks, he can vary how much attention he spends on one task versus another and in this way manipulate the compensation he receives.
Contract duration → (+) room for opportunistic behaviour	Agency Theory	Multi-period models make the management of principal-agent relationship even more complex. As is the case when the agent is responsible for multiple tasks, the private information of the agent becomes larger. When he can decide on investment levels for different periods, he can also distribute investments in the most productive way for him, which is not necessarily the one more convenient for the infrastructure condition and future performance.

3.3.2 The conceptualization of the evolution process

In order to answer the questions previously mentioned and after a preliminary research -including interviews and literature review- a first conceptual system dynamic model of procurement system was built. The model consists of a set of system diagrams that explain the evolution of the four main trends in road contracting. The dynamic view that resulted from the system analysis carried out is presented in the following subsections.

It is important to clarify that though in the analysis the introduction of the different practices is presented as following a neat and sequential chronological order; this is not necessary the case in most countries. The choice for a sequential approach is meant as an artefact of the system analysis method aiming at providing a clearer reasoning and illustration of the process. Such choice allows for the presentation of each innovative contracting practice in a separate diagram and consequently for a clearer representation of the influence each of them has on future choices and on the overall procurement system.

Original situation

In the initial situation, presented in Figure 3.10 the idea of the welfare state (Salminen and Viinamäki 2001) was predominant in most western countries. It is the purpose of the welfare state to restrict the effects of the markets on public services and welfare structures. In principle, the welfare state protects the people from the unequalizing effects of markets. Within the welfare state conception or paradigm, network infrastructures are considered natural monopolies and consequently a public management of them was considered the best option.

Beside this paradigm in the public administration sector, other two external factors that defined the environment of the road administration activity were fast growing economies and the specialization of work. As can be observed in Figure 3.10, concerning the performance of this system in terms of quality of roads and innovation we can see that; first, growing economies together with the public consensus that network infrastructures were a public task ensured enough funding resources to keep up with the maintenance and expansion of the network required. Second, large road administration agencies and the specialization of work, caused to some extent the domination of the technocracy which kept innovating and in some cases created even "gold-plating".

Therefore, we concluded that in this setting it made sense to have projects and contracts directly financed by the government, segmented, monitored on the basis of operational and detailed outputs and for short term. In this scenario private parties and market occupied only the position of a "hired hand" (Salminen and Viinamäki 2001) in the public sector.

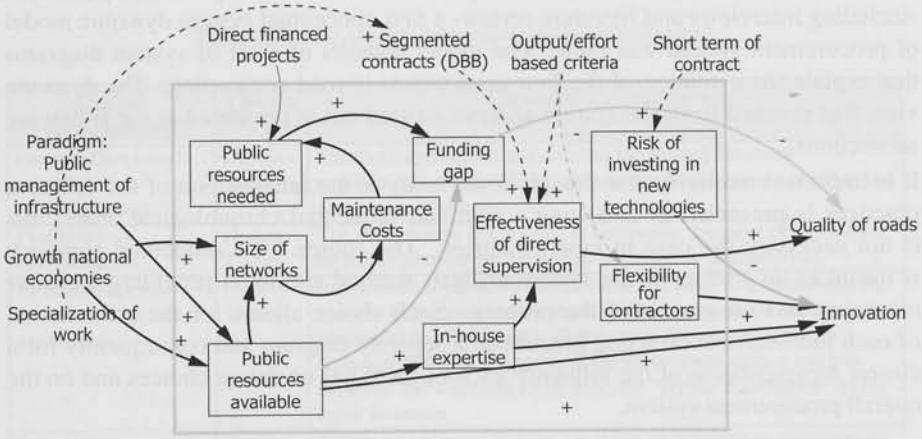


Figure 3.10: *System diagram of the original situation*

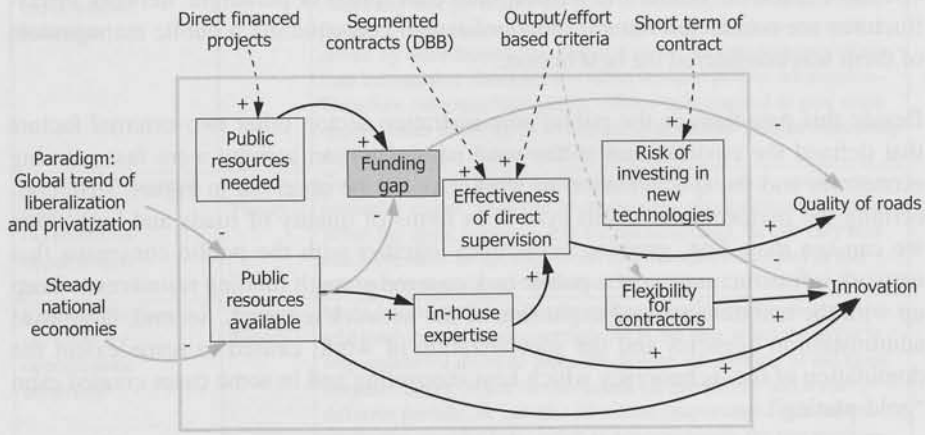


Figure 3.11: *Systems diagram of the situation under the New Public Management paradigm*

The beginning of change

The environment of the public sector has changed significantly in the last decades. The 1990s were a time of strident Anglo-North American insistence that public utilities were best suited to be delivered through self-sustaining competition and thus deliver price reduction (Arentsen and Künneke 2003). As explained before, a new paradigm in public administration emerged with the so-called New Public Management.

As is presented in Figure 3.11, this change in paradigm has caused a global trend of liberalization and privatization of public utilities, including road infrastructures. This trend together with the stagnation of national economies generated a funding problem. Different studies point out that insufficient funds to keep the required maintenance of the road transportation networks is a global problem (Pakkala 2002, Short and Kopp 2004, AECOM Consult 2005, Pakkala et al. 2007).

First trend

In reaction to this funding problem some countries have started to experiment with indirectly financed projects (financed by private parties, so as concessions and toll roads). Even when assuming that this new practice has solved the funding problem, another problem became the centre of attention: the effectiveness of direct supervision (see Figure 3.12) The liberalization and privatization processes have meant organizational reforms in the road administration authorities. In many countries, these institutions have been split in two parts; the pure client -responsible for tendering all phases of the road infrastructure- and the production or works portion. The former has remained a public agency and the second has been corporatized or privatized.

All in all, this has meant important loss of in-house expertise, which together with the growing role of the private sector, weakens the effectiveness of direct supervision. Traditionally the work of contractors was monitored using very detailed an operational indicators (e.g. rate of application of diluted emulsions). How to keep monitoring at this level of detail when the public agency has been left with less than half the original staff? And when most of the staff with know-how about the production has been transferred to the portion of the institution being corporatized or privatized?

Second Trend

Thus, once more a solution to this new problem was needed. Key Performance Indicators (KPI) are beginning to be incorporated in contracts. These indicators are more outcome-based than output or effort oriented (see Figure 3.13). The positive effects of this measure is that small public agencies can manage the road efficiently focusing only on the key strategic issues; and that more flexibility and therefore design space is granted to contractors, increasing the room or the probabilities of innovation (e.g. materials and processes).

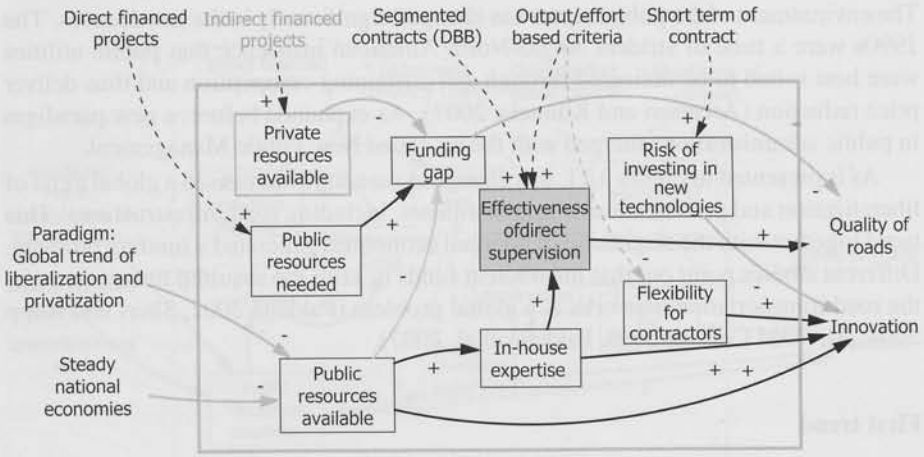


Figure 3.12: *System diagram of the first trend in procurement strategies*

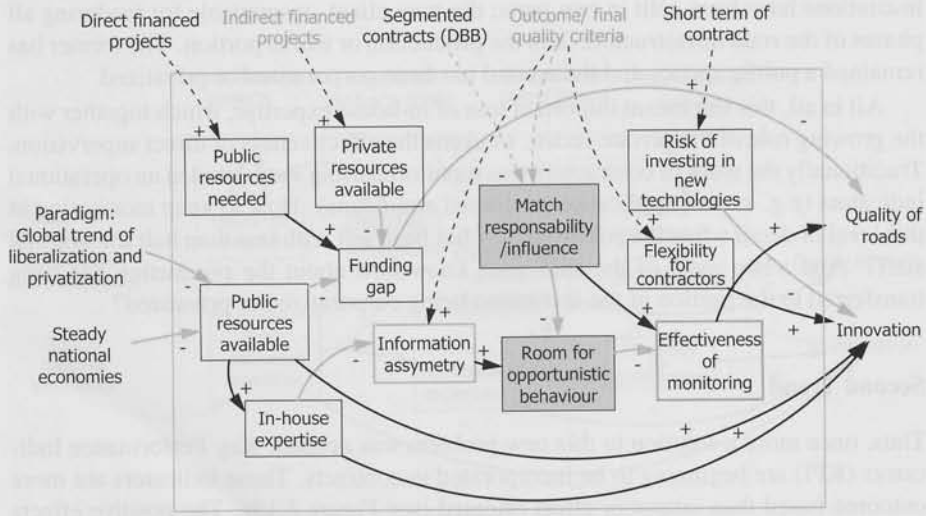


Figure 3.13: *System diagram of the second trend in procurement strategies*

Still, this solution engendered new problems. More room for opportunistic behaviour was created and the match between responsibility and influence was at risk. A focus on outcomes or results (e.g. number of accidents in the road) could mean that contractors are being held responsible for things out of their area of control or influence.

Third trend

An alternative solution to improve the match between responsibility and influence is to combine more phases of the road life cycle into one single contract (e.g. DBFO). In this way more factors affecting the final road performance became endogenous or under the control of one single contractor. If the same contractor is responsible for the design, construction, maintenance and operation of the road, he or she can be held responsible for higher levels of performance indicators than a contractor only hired for the maintenance of the road. Besides, an extra gain of this solution is a possible reduction on the total life cycle costs of the infrastructure.

Despite this advance, we can still detect problems concerning the room for opportunistic behaviour and innovation. Concerning innovation, the last two trends have increased the possibility of innovation, through an increase in flexibility and/or design space for the contractors. However, contractors are still refraining from adopting new technologies because they consider the risk of investing in them too high.

Besides, these two last reforms (combine contracts and outcome/final quality criteria) have not only increased design space but also the room for opportunistic behaviour, which ultimately threaten the achievement of the expected level of service and thus the fulfilment of public values. Here the tension between flexibility and public values becomes visible and clear.

Fourth trend

In this context we arrive at the fourth trend; an increase in the contract period in order to reduce the risk for contractors in investing in new technologies. Once more, though a positive impact on innovation is expected, a longer contract period also means an increase in information that can be kept from the government (Lambert 2001), and therefore the room for opportunistic behaviour grows.

3.3.3 Problem diagnosis and preliminary findings

The formal analysis of innovative contracting practices in terms of agency theory and engineering design theory indicates that innovative contractual arrangements fit better with the definition of neoclassical contracts. Innovative contracts -characterized between others by the integration of various life cycle phases of the infrastructure, long-terms and the creation of bilateral dependencies- match better the definition of

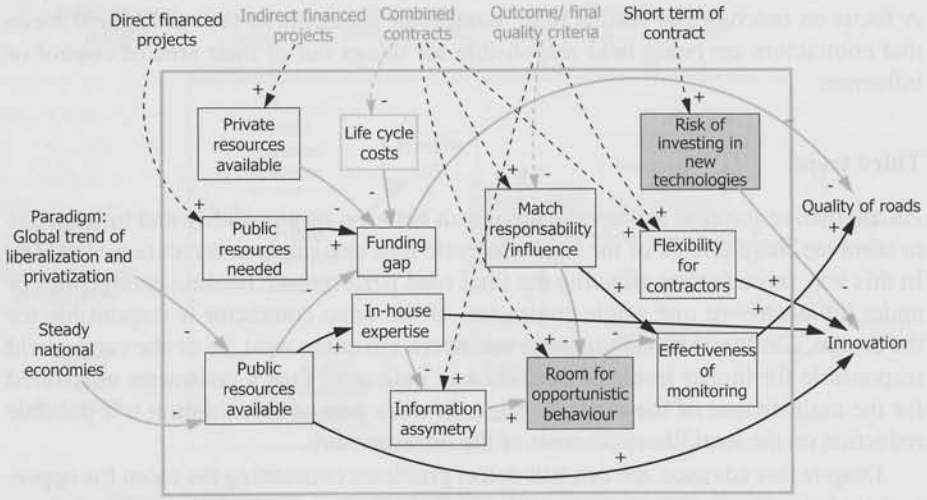


Figure 3.14: *System diagram of the third trend in procurement strategies*

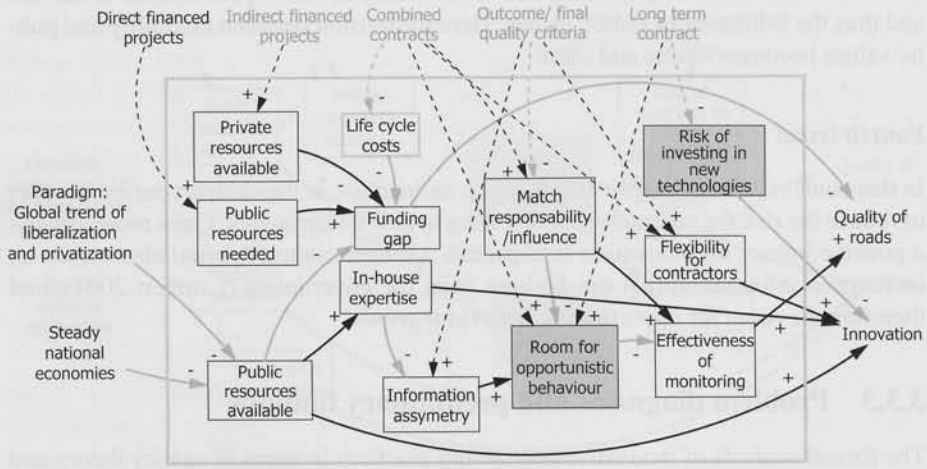


Figure 3.15: *System diagram of the fourth trend in procurement strategies*

neoclassical contracts and hybrid coordination mechanisms than that of classical contracts coordinated through markets. Accordingly, any further comparative study and analysis of these practices should incorporate additional notions besides the ones offered by agency theory. In other words, it should incorporate theoretical concepts that are more in line with this new type of contracts (i.e. not per definition self-enforcing or complete) and that allow for the explicit handling of issues such as uncertainty and the need for formal and informal enforcement mechanisms.

The analysis of the road procurement system and the changes brought by the adoption of innovative contracting practices has contributed to a better understanding of the problem at hand and raised a number of issues that require further attention.

To begin with, the tension between technical aspects of flexibility and public values was clearly captured in the system diagrams: increasing flexibility has had an impact in the room for opportunistic behaviour. Flexibility -operationalized as design space granted to contractors- has been increased aiming at more innovation in the sector and higher service levels. In other words, aiming at achieving public values more efficiently. Nevertheless, the contracting practices implemented in order to increase such flexibility also appear to increase the room for opportunistic behaviour; which -if exploited by contractors- may translate in quality decline and pose a serious threat to the safeguarding of public values in the long term. Accordingly, as authorities advance in the use of innovative contracting practices the dilemma they face is; how to keep the right balance between flexibility in contracts and control over contractors or safeguarding of public values; or between flexibility and security? Their problem can be better formulated as follows: *How to achieve the results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (of contractors) and the (negative) effects of it at the minimum possible?*

In general, one needs to be careful about the results expected from the application of innovative contracting practices. The attractive efficiency wins and savings reported by some countries appear to be the result of proper timing and implementation order of different contracting practices, probably combined with favourable external factors and extra policy measures that counter balance the perverse effects of some of these contracting practices. The system analysis also indicates that the different trends in contracting are interdependent and to some extent some are the logical reaction to problems caused by the solution given to the problems created by the previous trend. Synergy is expected for example towards achieving innovation. If policies increasing the flexibility or design space or contractors are implemented together with policies that reduce the risk for the contractor to invest in new technologies, their combined effect in innovation is expected to be larger than when applied individually.

Nevertheless, in order to draw more concrete conclusions about the pros and cons of applying these new contracting practices and about preconditions or requirements for success; further research is needed. First, research on how different road authorities have dealt in practice with this dilemma, which lessons can be learned from pioneer-

ing nations and the way they have solved this tension between the technical aspects of flexibility and safeguarding of public values; while also aiming to gain understanding about possible synergies and conflicts between contracting policies observed in practice. Second, realization of experimental study or research of alternative solutions to this dilemma that contributes with concrete advice or guidelines about how to build the right incentives in this new type of contracts. In order to realize such research an instrument or tool may be needed.

The development of such a tool or simulation model poses a number of challenges and raises critical questions, some of which are:

- Should one single generic model with many decision rules be built or a set of different models. If one single model is built, how could such a deterministic model -if system dynamics is chosen as the modelling approach- be built to deal with structural changes that result from the implementation of new policies?
- Can the problem be modelled at this level of aggregation, with variables such as in-house expertise and room for opportunistic behaviour; and still obtain meaningful or accurate values for the results of these new practices in terms of performance? Or is there a need to model the underlying physical flows and stocks?
- Does the physical infrastructure itself needs to be modelled or only modelling the operation of it will suffice?
- How could soft variables such as "room for opportunistic behaviour" or "opportunistic behaviour" be included in the model? Could they be modelled by making use of system dynamics or are other techniques like role-playing or gaming-simulation more appropriate for this goal?

System dynamics appears to be a suitable methodology for elucidation of evolutionary processes involving many interdependent variables and self-enforcing processes. Nevertheless its use for the development of a simulation tool still poses two important challenges. First, regarding the way "soft" variables -like opportunistic behaviour- resulting from the choices of diverse economic agents can be modelled. Second, regarding how structural changes -resulting from the implementation of new contracting practices- can be integrated in a single deterministic model. A plausible alternative to overcome this problem may be to combine a system dynamic or any other mathematical model that simulates the physical condition of the road network and role-playing games to simulate the soft variables required.

3.4 Trade-offs in road network maintenance

This section presents an illustration of the many trade-offs and decisions that are nowadays realized by public infrastructure operators and which may be transferred to private contractors if innovative contracting practices become the norm. With this

purpose, system analysis and system dynamics techniques are applied to the technical specificities of the road infrastructure system, the issue of road network condition and the impact of different maintenance activities.

As previously explained, many transportation agencies are experimenting with innovative contractual arrangements for the procurement of construction, maintenance and operation of roads. They are changing from traditional contracts that prescribe the kind of work that need to be done in a specific section of the network, to more flexible contracts. Such contracts are expected to broaden contractors decision rights and freedom to its maximum level; a contracting setting where the contractor itself decide which road section, when and what kind of work he will perform, with the only condition of guaranteeing a certain level of performance for the whole road network assigned to him.

All these changes are taking place in the middle of much uncertainty and many knowledge gaps; partly driven by financial deficits of governments (as actors declared for the case of Spain), insufficient human resources in road agencies (as it seems the case in Finland) or simply trend following. Therefore before all these decision rights are transferred to the private sector, it is urgent to create awareness of the many and crucial trade-offs that are nowadays made on a daily basis by public servants in charge of these road networks.

In order to illustrate these trade-offs a qualitative system analysis of road network condition -for a cold climate country- has been conducted. Such an open box kind of analysis allows the investigation of these trade-offs in a more structured way as well as it allows the logical analysis of the implications of innovative contracts for the condition of the road network, the economic performance of the system and the protection of public values.

The analysis carried out will be presented as follows. First, an outline of the situation in road maintenance -actual organization, actors involved and possible scenarios in the future- will be presented along with the boundaries of the system to be studied. Second, the most important trade-offs in road network maintenance (more concretely management of pavements as this the highest impact on network condition) will be explored by means of causal loop diagrams (CLDs). Third, by expanding the boundaries of the system it will be shown how the management of pavements as subsystem and the choices taken within it, influence and are influenced in return by choices taken in other subsystems, such as the procurement one. Finally, a number of opportunities and threats or challenges posed by innovative contracting practices are formulated.

3.4.1 Methodological positioning

Extensive work has been realized on the development of quantitative models (HDM models) by organizations as the World Bank (Kerali 2000) to help road agencies make good decisions and planning of their maintenance actions. More specific mathematical models have been developed for the prediction of pavement deterioration rates

(George et al. 1989, Duffell and Pan 1996) and pavement life cycle management. However these models need careful "adaptation" to each country conditions -see the work of Bennett and Chakrabarti (1994), Sharma (1994)- and seem to be more focused on developing countries where service levels and standards are somewhat lower and user's expectations and demands do not make visible some of the important trade-offs that road administrators of countries with more developed networks, like Finland or the Netherlands, face. They are actually meant as hand-on models for road engineers working in road agencies and treat therefore more operative and planning related decisions than strategic ones.

The analysis realized and presented here aims instead to reflect upon more strategic kind of decisions. The choice for white box analysis of the kind proposed by system dynamics seems appropriate to discover the most relevant trades-offs faced by decision makers responsible for the maintenance of roads and to make them more accessible for policy makers in the area. As Mass describes: "A system dynamics model is intended to yield operational insights about feedback relations that can produce or contribute to problems, can counteract policy interventions, or can reinforce benefits of policy action aimed at high leverage points" (Mass 1991, 68).

System dynamics and other modelling techniques have certainly been already used to study road management and road policies. In an extensive literature search, three main groups of work, depending on the focus or research objective, have been noticed.

The first group treats with rather operational problems with a somehow lower level of aggregation. Here one finds works like the one of Wang et al. (2005) on the prediction of traffic volume.

The second group of works does show a higher aggregation level and tackles more strategically important issues of road procurement, but concentrates on project performance or performance of construction companies; and therefore is less directly related with maintenance and operation of road networks, the main focus of this analysis. Here one finds the works of Reichelt and Lyneis (1999), Lyneis et al. (2001), Chritamara et al. (2002), Ogunlana et al. (2003), Lee et al. (2005).

The third group does research on road maintenance at the same aggregation level that the analysis proposed here. Here one finds important contributions in the works of Garza et al. (1998), Vassallo and Izquierdo (2002), Friedman (2006):

Friedman (2006) investigates the impact of highway maintenance policies on accident development. He argues that a counter-productive policy may be creating serious consequences on road safety. He uses a system dynamics model to evaluate the effect of road condition on accident development, and the results ask for a re-evaluation of the concept of maximizing road repairs. The analysis shows that an increase in repairs causes an increase, not a decrease, in the rate of accidents occurrence; "This is counter to both the reasoning and actions being taken by pavement managers to reduce the rate of accidents" (Friedman 2006, 378). His results suggest that alternative highway design should be considered in order to decrease the rate of accidents and to avoid increasing spending aimed at improving conditions.

The work of Garza et al. (1998) differs with the one of Friedman in that they do not research on the issue of safety but focus on the classification of factors and the description of the model; and less on presenting the understanding gained by building and using the model. This is probably the result of different research purposes. Their model was developed as a comprehensive Decision Support System for Virginia Department of Transport (VDOT) and it is consequently more similar in capabilities to the HDM models than to the model developed by Friedman.

Finally, another key work is the one of Vassallo and Izquierdo (2002). Although they do not make use of system dynamics, their work do develop a complete and integrated model of road management and it is therefore interesting to review. Vassallo and Izquierdo (2002) also touch upon financing and maintenance of roads, but from a different perspective than Friedman. Their work is also different from the one of Friedman, since they do not evaluate the impact of financing on safety. It is different than previous works in that they do not estimate best investment strategies for fixed budget policies, but they instead research the benefits in terms of productivity increase; of different financing and contracting formulas. These formulas range from public budgets to levying a variable charge (proportional to the capacity for deterioration of each vehicle class) on road users to finance road maintenance. Here special attention is given to performance-based maintenance contracts and indirect financing, two of the four trends previously analysed. They developed a model comprised of five sectors (pavement deterioration, transport cost, maintenance expenses, traffic volume and management and financing sub model); of which three condition-related ones are based on the mathematical equations of HDMIII and HDMIV models. They validated their results with an application on a secondary road in Spain. They concluded that there is no great deal of difference between total benefits of the different mechanisms, unless optimum resources are allocated; and it is precisely in this problem of insufficient funding where indirect and private financing may help in eliminating budgetary barriers.

In spite of these innovative applications, within road sector practitioners, the use of system dynamics to support decision making processes does not seem to be widely spread. The daily practices of road network management seems rather characterized by specialized studies realized by different experts, each of them emphasizing or advocating for different problems depending on the perspective they take when studying the system, or depending on the particular role they play in the road sector.

A large amount of technical research has been undertaken by mechanical engineers on road deterioration, road design and related issues, but most of this work aims at explaining or developing mathematical models for single causal relationships. Within the so-called "vehicle dynamics" -from mechanical engineering- many authors research on the impact of automotive technology on road deterioration. This is rather important since changes in this technology could dictate the obsolescence of many relationships (as the Vehicle Operation Cost or VOC) that form the basis of the HDM models. Some of the causal relationships explored in this discipline are: the relation-

ship between vehicle design and road deterioration rate (Ahmed et al. 1985, Ren and Jin 2004, Ren et al. 2005); between road condition and drivers' experience (Schiehlen 1984, Misun 1990) of the road; and between road design and vehicle speed control and therefore safety (Salau et al. 2004). Other specialists have researched widely on the impact of winter weather conditions on maintenance costs and fewer on the impact of these conditions on safety (Strong and Shvetzov 2006).

In this way road engineers emphasize the problems of cracks and ruts, and propose measures as reconstruction and enforcing the strength of unbound structures. Meanwhile traffic experts see the "road network" and its condition as given (assuming total availability and serviceability or at its maximum considering it a constrain) and focus on problems such as travel time, best routes and would probably propose expansion of the network and on time travel information. Last but not least, users too have their view. For users is important the service they receive as a whole, independently of who is the responsible for it and how good are the separate tasks realized (e.g. winter maintenance, periodic maintenance or traffic management). They judge the road system as a whole, not the physical network apart from the services. Besides, it is important to remember is that they also have an influence on the way the system behaves and performs.

Therefore the construction of a system view, and when possible a simulation model could be of great help:

(1) To understand the behaviour of the system as a whole, to discover and understand the tradeoffs between decisions of one area of expertise and another, and their consequences.
(2) To discover solutions with more synergetic power (leverage points) and longer term effects.
(3) To communicate with society about their own responsibilities and the hard choices that need to be made.

3.4.2 The sector of periodic road maintenance

Until now design freedom granted to contractors is quite small. Periodic maintenance is outsourced but payments and quality controls are done immediately after the project is realized with no functional specifications but rather supervising them in the process and the final thickness of the pavement, roughness, and other physical characteristics. Projects are until now also tendered as work orders, for small sections and one time works. Therefore the contractual relationship last has a very short time, last only the same time than the duration of the work.

Nevertheless plans for the future are either to combine periodic maintenance with routine or winter maintenance activities (like snowplowing and deicing) and eventually with operation tasks; or to reorganize the actual work order kind of contracts into bigger work packages like all the bridges of a municipality or road sections of longer

extension. Both possibilities envision longer term contracts and would require a different distribution of responsibilities and risks between the actors already active in this sector, like contractors, consultants -in design and geotechnical areas- and of course the Road Agency.

Pavement management cycle

A pavement management program consists mainly of tasks such as Policy, Management, Planning, Programming, and so forth, progressively translating very general guidelines into a concrete list of "works" to be realized by each district or region and further into a set of contracts to be tendered. The following figure shows all the consecutive phases common to all pavement management programs or so-called Pavement Management Systems (PMS) nowadays in place in nearly all developed countries, and promoted by the World Bank also -though following a somewhat adapted own model- in many developing countries (Finn 1998). PMSs have been implemented by national road authorities in the Netherlands since the late 80s, and in Finland and Spain since the early 90s.

As it can be observed in the Figure 3.16, a PMS provides the framework within which to organize and carry out all the work activities needed to provide and maintain the national pavement network. It has been also defined as a system which involves the identification of optimum strategies at various management levels and maintains pavement at an adequate level of serviceability (riding comfort) (Finn 1998, 4); or a systematic process that provides, analyses and summarized pavement information for use in selecting and implementing cost effective pavement construction, rehabilitation, and maintenance programs.

As stated before these phases are similar in all national systems (Molenaar 2005); nevertheless differences may exist in the list of criteria or weight assigned to them, used as basis for the final decision on which maintenance works are prioritized and for which rehabilitation strategy is chosen. Alternative decision models between many are the conventional network optimization model, a model based on financial consequences (Bemanian et al. 2005) or the so-called "Lifetime-Extending-Maintenance" model (Stijnen and Noortwijk 2004) developed and used in the Netherlands.
Until recently the regional offices have done the programming, planning and procurement themselves, with support from consultants. Nevertheless plans are to organize contracts in such a way that, either a contractor takes care of the whole process starting even from planning and hire consultants as subcontractors; or the other way around, consultants may do all the activities from programming on and hire themselves construction contractors. In total there are four possible scenarios that will be discussed later.

Future scenarios in periodic maintenance

Possible future scenarios for the maintenance of roads are the following:

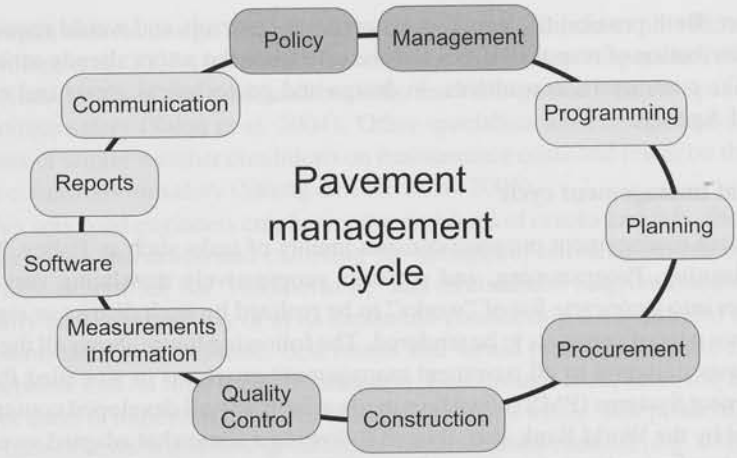


Figure 3.16: *Pavement Management Cycle (Translated from Finnish. Source: Ramboll Finland Oy 2006)*

(1) Traditional situation: where road authority tenders out a specific section of the road and with a specific action and mix of bitumen's prescribed.
(2) Contractors are hired to repair a specific section of road, not told exactly what to do, but expected to give a guarantee of five years.
(3) Contractors take care of a whole area, programming and planning, is paid a fixed service fee per year (lump sum) and in coordination with design consultants perform the proper works to ensure a certain service level or annual objective (i.e. 80% of roads are in sufficient condition).
(4) Design consultants take care of a whole area, they are paid a fixed service fee and they are the ones who hire construction subcontractors and look after the quality of their job, in order to ensure a certain service level.

Actors

The most important actors in the sector of periodic maintenance are: Headquarters of road administration. Their goal is to keep the national road network in a condition that ensure certain public values such as mobility, accessibility, and so forth. Regional offices of the road administration. Their goal is to keep the local road network in the condition required by higher government levels. "Their drive is to not only to keep roads in a usable condition but to also keep the rate of accidents and their associated costs to a minimum" (Friedman 2006, 374). Contractors. Their goal is to earn money by maintaining roads. Design consultants. Their goal is to earn money by giving advice to the road administration or to consultants. Users and residents. Their interest is to reach place A or B, comfortable, fast and safe trip.

The problem

Advanced computer models have been developed that can calculate what would be the resulting road condition for given investment decisions (prioritizing high or low volume networks) and actions (from very light actions such as filling potholes to very heavy actions such as reconstruction of structural or unbound layers). Nevertheless it remains uncertain what kind of decisions would be better to leave to consultants, to contractors or to the Road Administration, given their special know-how and interests; and therefore which arrangement or scenario would be the best. What decisions would they actually take, given the different weights they may assign to technical, economic or political criteria?

Defining the system

For the study of the periodic maintenance system the following boundaries have been set:

The physical road network and its condition will be explored, assuming a fixed quality or level of service of winter maintenance:

- The causal map represents the interrelations for either of the networks (i.e. low volume and high volume). The importance or magnitude of these relationships will be differentiated by assigning different parameters when the specificities of the model are being worked out in a further stage.
- Seasonal differences -like the problem of sliding during the winter or hydroplaning during the summer- will be also worked out properly during specification of the model.

Once fixed the boundaries for the system analysis, it is important to define the main outcomes to be considered and that will serve as reference point to weight the different trade-offs and make proper decisions between different policy alternatives. The outcomes of interest considered, taking the public road authority as the problem owner, are:

- Environmental pollution
- User's cost: understood as travel time plus vehicle cost (e.g. change of tires)
- Actual level of service: offered to users -as defined in the 5 classes or condition categories[4] being used by many national governments- and being the result of; actual overall (physical) road condition and quality of routine maintenance.
- Societal costs: understood as the number of accidents and specially of fatal accidents taking place on the road network

[4]Belgium, the Netherlands and the UK use a system of 5 categories -very good, good, reasonable, mediocre and bad- to classify the condition of their roads. A condition of 1 means perfect or very good with no signs or damage or just signs of initiation and a condition of 5 is bad with a degree of damage that represents a threat to safety and functionality.

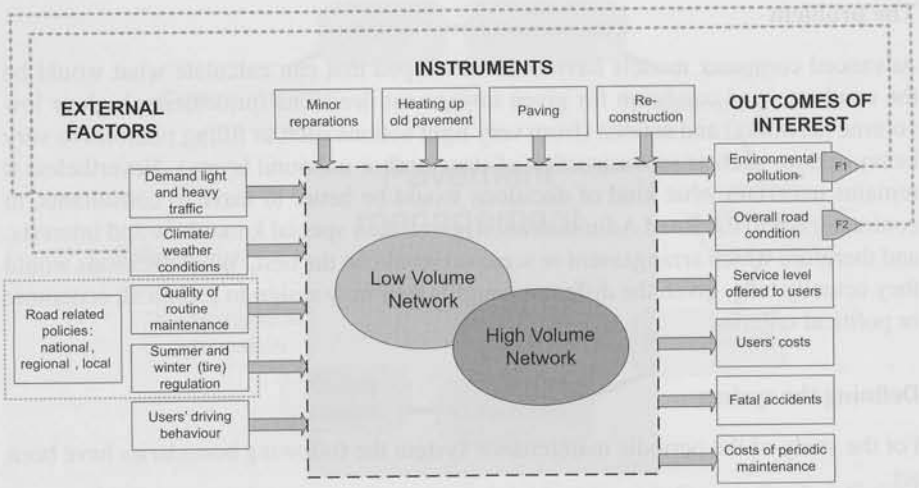


Figure 3.17: *System diagram of the pavement management system*

- Total costs of periodic maintenance

The main factors that influence the performance of this system and that are not under the control of the Road Authority:

- Demand for heavy and light traffic (we considered them dependent on the different sectors)
- Climate and/or weather and herein more specific: temperature, moisture, rain, and circumstances on the road.

Further, not under the control of the pavement managers:

- Quality of routine maintenance
- Regulations for summer and winter tire (and other seasonal regulations)
- Users' driving behaviour, like driving speed
- Regulation on heavy vehicles

Now considering the instruments, measures that can be taken to influence the performance of the system, we could mention from lighter to heavier:

- Reparation of potholes and similar problems
- Heating up of old pavement
- Paving or resurfacing
- Reconstruction

Besides these instruments there are all kind of parameters or standards that make part of the policies of the road administration that also influence the performance of the system, for example:

- Coverage of the maintenance action
- Threshold values
- Weight limits

All the elements reviewed lead to a system depicted as follows (see Figure 3.17).

Defining road condition and level of service

Since the main indicator for periodic maintenance is and will continue to be the condition of the road network, it is essential to give first an outline of all the aspects that define this condition or the so-called serviceability of the pavement. These aspects will come back in all the causal loop diagrams (CLDs) that will follow.
The most important condition variables -defined in Table 3.3- are:

(1) Referring to the condition of the unbound structure: structural strength or bearing capacity
(2) Referring to the condition of the bound layers or surface: There are two profiles that measure the condition of the surface layer, transversal and longitudinal. The transversal profile include ruts, and sum of defects. The longitudinal includes longitudinal evenness (IRI) and road texture. The longitudinal profile of the roadway is important for the driving comfort as well as the driving safety.
(3) Besides in a somewhat different category is the phenomenon of cracks that also define the condition of the road but cannot be considered part of the transversal or longitudinal profile alone. Ruts together with sum of defects are considered structural defects because their appearance points out to the probable low quality of the unbound structure.

Further it is important to explain that road condition could be decomposed in three aspects: Actual or real condition in certain point in time, which is a stock. The deterioration taking place yearly, which is a yearly rate and therefore a flow. The upgrading taking place, which is like deterioration a flow.

For the specification of road condition -when building the model- two alternatives are possible within the system dynamics methodology. First, as presented in Figure 3.18 where road condition is considered a continuous scale with a numeric value. Then upgrade is considered an inflow that increases the road condition and deterioration and outflow that decreases
Second, when road condition is to be conceived not as a continuous scale but rather as a group of different stocks that relate to different condition categories (A, B, C, and so forth); then the best option is to consider deterioration as a flow that brings roads in top quality to become roads in a lower quality and contrarily, upgrades would bring

Table 3.3: *Condition variables for a road section*

Profile	Variable	Proxy	Meaning	Direction
Transversal	Ruts		The lateral profile of the road is important for the safety of driving and the comfort of the driver. Distinctive lane grooves can make additional steering powers necessary and can lead to aquaplaning. The relevant quantities for the lateral profile of the roadway are the depths of the lane grooves, the depth of the profiles and the theoretical water gauges under the right and left wheel of a lane.	The less the better
Longitudinal	Longitudinal evenness	IRI	The IRI (International Roughness Index) measures the cumulative deviation from a smooth surface in inches per mile (or metre per kilometre). The difference with texture is that this includes the dynamics of the vehicle and that the wavelength is different.	The less the better
	Road texture		Texture means the geometric fine shape of the road surface, expressed in the parameters wavelength and amplitude. Texture contains form, size and distribution of the aggregates. Texture ranges from a wide wavelength spectrum from micrometre to decimetre. One distinguishes between micro texture, macro texture and mega texture. Wavelengths above 0.5 m are assigned to evenness. The parameter labelled here as texture belongs to macro texture.	
	Categories	Micro Texture	(up to 0.5 mm wavelength)	
		Macro texture	(0.5 mm - 50 mm wavelength) In moist conditions the macro texture of a road surface is essential for the drain behaviour and the level of the tire grip.	The more the better
		Mega texture	(50-500 mm wavelength) This variable is associated with the roughness (or evenness) of a road and therefore causes: sound, tire wear and rolling resistance (fuel use)	The lowest the better
Structural Defects	Cracks		The phenomenon of cracks is a difficult one. Cracks can be classified as: transversal, longitudinal, edge, alligator or multiple cracking. A proxy that can be used to measure them in general is percentage of surface cracked.	The less the better
	Sum of defects		Important for low volume roads, and if structural strength is not known could be important to have this measure.	The less the better

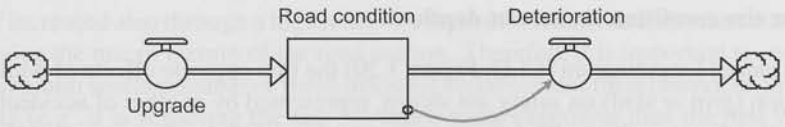


Figure 3.18: *SFD for road condition when considered a continuous scale*

roads in a lower class to a higher one (see Figure 3.19). This could be probably the best option given the actual classification used for road condition and the units used in many of the measurements, which normally are road sections of a determined length.

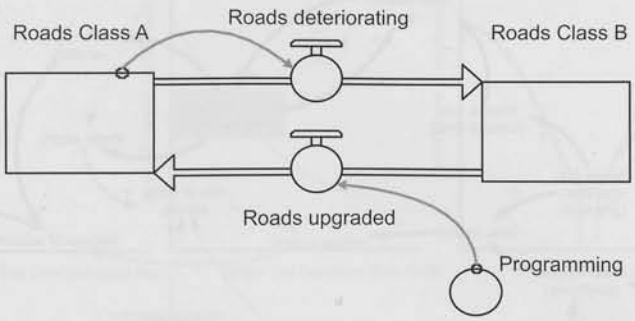


Figure 3.19: *SFD for road condition when considered as a set of intervals*

The final choice will depend on the abstraction level used and the purpose of the quantitative model. It will depend whether the goal is to simulate one single section of the road and the behaviour of it throughout the years or to simulate the behaviour of the whole national network. At the national policy level, discussions about road condition and the setting of goals are mainly and often based on the statistics that classify roads in different condition categories -mostly five- from very good to very poor where the road is considered to have no more functional life. Nevertheless most of the quantitative data available is in terms of deterioration levels or damage rating for each of the aspects previously mentioned -cracks, rut depth, texture, and so forth- in a separate way and remains difficult to define which level of damage for each of these aspects make a road section classify in top or mediocre condition.

3.4.3 Exploring the causal relationships and discovering trade-offs

In the following sections the different parts of the system will be reviewed and a causal analysis will be realized for each of them.

Winter tire condition versus rut depth

In this causal loop diagram (CLD, Figure 3.20) the two opposite effects of winter tire condition (grip or skid) on safety are shown, represented by number of accidents:

First, a direct positive effect -more important during winter- by increasing the total friction between tires and road, which makes easier for drivers to keep control of their cars and therefore reduces the chances of accidents.

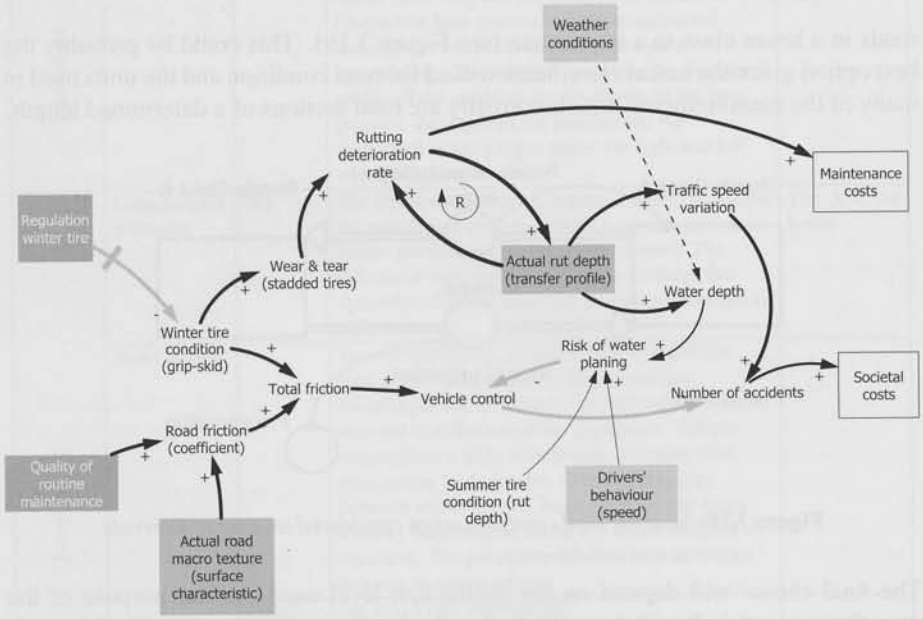


Figure 3.20: *CLD of winter tire condition versus rut depth*

Second, a negative effect -more important during summer- due to the acceleration they cause in the deterioration rate of the road, through the phenomenon of Wear and Tear. The heavier the tire skids the more the rutting deterioration rate and the actual rut depth. The deeper the ruts on the road, more water can be accumulated (in case of rainy road circumstances) increasing the chances of hydroplaning accidents.

It is therefore important to weight both effects and find the range that is best for reducing both kind of accidents, or that allows the most cost effective maintenance of the road. As shown on the following curves, the variable Winter Tire Condition does not have a single direction but rather shows a (asymptotic) parabola like behaviour (as shown in curve c), which results from the combination of both effects previously explained and shown in curves a and b (refer to Figure 3.21).

The boundaries of the system can be broadened to explore the impact of other policies in the friction related accidents. By doing so we discover that total friction

can be increased also through a higher service level of winter (routine) maintenance or improving the macro texture of the road section. Therefore it is important to research the maximum levels possible of these different variables and their behaviour in terms of costs (e.g. it is achieving the last 5% much more expensive than the first 95%?). Once information about these different aspects is known, better informed decision-making could be achieved, a process that will include, for example, the following possibility: Could it be invested extra in winter maintenance actions what is now invested in the reparation of ruts and achieve in this way a much better performance in terms of safety and costs?

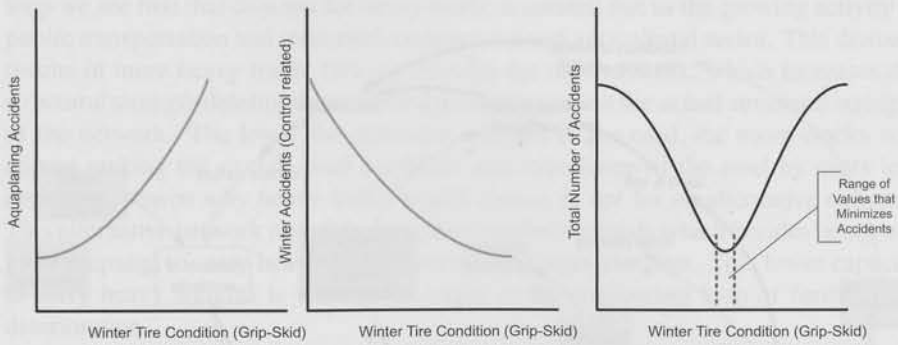


Figure 3.21: *Effect of winter tire condition on the number of accidents*

Important to notice in this first CLD is the reinforcing loop that takes place in the rutting process (the more the actual rut depth, the bigger the rutting deterioration rate and the higher this, the more the Actual rut depth will be) and which could provoke a fast and exponential process of deterioration. Such reinforcing processes do not seem to take place in the area of routine maintenance. This could mean that one could expect an investment in the reduction in the rate of rut deterioration to be more effective or have a higher impact in the overall performance of the system (in terms of safety) than other measures with the same cost. In other words, it could be more effective to try to increase friction through other ways that do not activate or worsen the rutting deterioration rate as the winter tire grip does.

It seems also then that improving winter maintenance is an easier point of influence, since this does not show side effects, as winter tire skids do. Here the questions would be, can we really improve the quality or winter maintenance much further?

Other aspects to be noticed are the factors dependent on road users -that could also be a way to solve the whole issue of safety and risk of hydroplaning. Here only two are considered:

- Driver's behaviour, mainly speed
- Summer tire condition

The effect of routine maintenance

Continuing along these lines, Figure 3.22 explains in more detail all the factors that play a role in road friction and vehicle control, and ultimately result in societal costs (mainly accidents). These factors are:

- Quality of routine maintenance (through the use of sand and salt , snowblowers and de-icing equipment) and macro texture of the road
- Condition of winter tire
- External Factors such as drivers' behaviour and weather

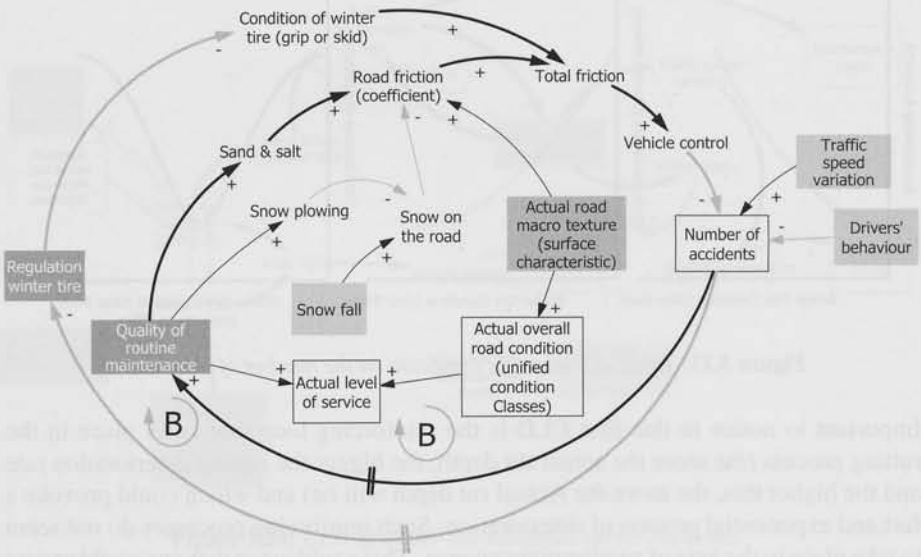


Figure 3.22: *CLD of routine maintenance and its influence on system performance*

In the diagram we can see two important balancing loops. The first goes from number of accidents to winter tire regulation and total friction. The number of accidents during this winter -if exceeding a certain value- will probably have an effect on next year winter tire regulation, specially if the statistics show an important increase, the government will probably allow next winter tires with more grip. Though other solutions may be better, this is an immediate measure that makes everybody -especially drivers- feel more in control of the problem.

The same happens in the second balancing loop with the quality of routine maintenance required from contractors. However, it is important to mention that this policy may have a limit, since it may be too expensive or impossible to reach higher standards of winter maintenance after a certain threshold.

These two balancing loops and delays will probably cause oscillating behaviour of the system performance in term of number of accidents. If one considers the effect of winter tire regulation on hydroplaning, here instead of a balancing loop a reinforcing loop would be turned; one that will gradually along the years mean a continuous deterioration of the road network.

Structural strength and the influence of heavy traffic

From all the causal relationships shown in Figure 3.23 the most important to mention are the two big feedback loops, one reinforcing and one balancing. In the balancing loop we see first that demand for heavy traffic is created due to the growing activity in public transportation and industrial, commercial and agricultural sector. This demand results in more heavy traffic flowing through the road network, which increases the structural strength deterioration rate and therefore worsen the actual structural strength of the network. The lower the structural strength of the road, the more cracks will appear making the overall road condition and experience of the road by users less appealing, reason why heavy traffic would choose to opt for an alternative network. This alternative network probably comprises secondary roads which besides being less good prepared to carry heavy weights represent longer journeys. This lower capacity to carry heavy weights is what gives origin to the reinforcing loop of further road deterioration.

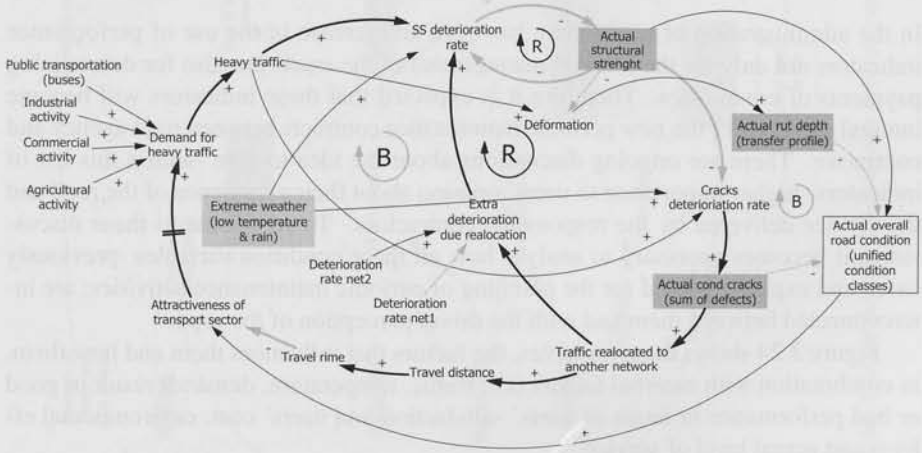


Figure 3.23: *CLD structural strength and consequences of heavy traffic*

All in all if the condition of the road is so bad that heavy traffic reallocate to other networks, their travel distance and travel time will increase (which directly increase their costs and reduces their competitiveness in the market of transportation) making the transport sector in that country or area less attractive. This lower attractiveness

could eventually or in the long term translate in a decrease in demand for heavy traffic. This will happen with bigger probabilities if the time the network remains in bad condition is long enough and if there are alternative ways of transport mode or routes in neighbouring countries. In this way the loop is closed and the initial high demand of heavy traffic, affected itself back in a negative way, or in other ways, it balanced itself. However, the problem here is the presence of a reinforcing loop in the deterioration process, which means that even assuming that heavy traffic will diminish, once the condition of the road is poor, it will keep getting worse and worse in a faster pace. In the meantime the competitiveness and attractiveness of the national transportation network will diminish.

The main reinforcing loop starts with a higher deterioration rate of structural strength, which worsen the overall road structural strength, accelerating the process of creation of cracks and worsening the road condition (sum of defects), which as explained before, result in heavy traffic choosing for an alternative networks. If this second network being opt for has a lower structural strength than the initial network, the more heavy traffic is making of it, the more extra deterioration will take place, accelerating the process of deterioration of structural strength of the overall road network. In this way the deterioration process reinforces itself, creating a sort of vicious cycle; unless corrective actions are taken on time.

Interdependencies between condition variables and users' perception

In the administration of roads there has been an increase in the use of performance indicators not only for the internal management of the assets but also for determining payments of contractors. Therefore it is expected that these indicators will become integral elements of the new periodic maintenance contracts between road agency and contractor. There are ongoing discussions about the idea to give -within this list of indicators- higher importance to users' opinion about their experience of the road and the service delivered by the responsible contractors. To contribute to these discussions, it becomes necessary to analyse how all these condition variables -previously listed and explained- used for the planning of periodic maintenance activities; are interconnected between them and with the driver perception of the road.

Figure 3.24 shows these variables, the factors that influences them and how them, in combination with external factors (i.e. traffic, temperature, demand) result in good or bad performance in terms of users' satisfaction and users' cost, environmental effects and actual level of service.

In order to understand better the different causal relationships shown, we will first define what is meant by the actual overall road condition, then we will explain the effect of the different external factors in the road condition, and finally we will explain the different outcomes or key performance indicators of the system. As shown on Figure 3.24, overall road condition depends on:

- Structural strength: the more the better the condition of the road

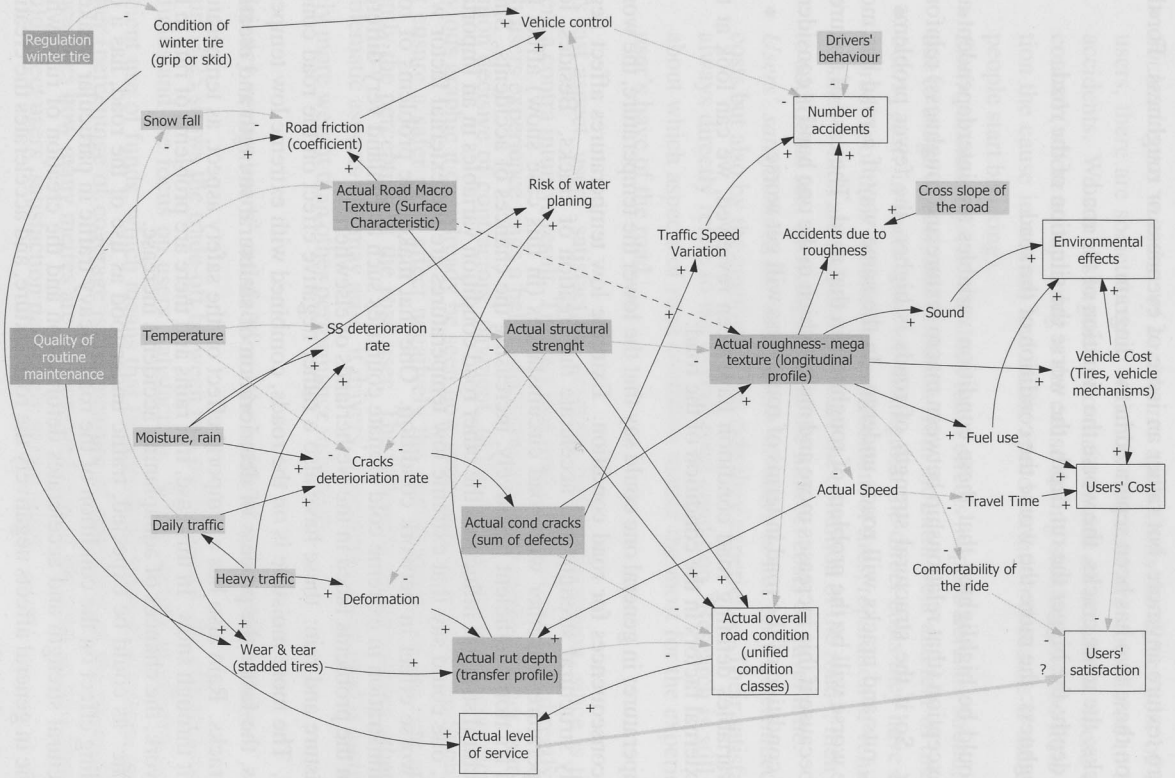


Figure 3.24: *CLD of the interdependencies between condition variables, users' satisfaction and other outcomes*

- Macro texture: the more the better, but notice that this has a limit. As explained before if this surpasses the value of 0.5m of wavelengths, then it is not considered as
- macro texture anymore, but rather an issue of evenness or roughness. For this reason these two has been separated in the diagram.
- Cracks: the more cracks, the worse the situation of the road.
- Rut depth: the bigger the rut depth, the worse the situation of the road.
- Roughness: the more the worse the condition of the road.

Here it should be highlighted that these condition variables are interdependent and with one exception (that relationship between macro texture and roughness) reinforce each other. So if the structural strength of roads is higher, the fewer problems of roughness, ruts and cracks will roads undergo. In the same way if a road has more cracks, the worse will be the problem of roughness in that road. The case of texture is different, because if this increases more and more -which in the one hand is considered good-, the condition of the road in terms of roughness will get worse.

Now the variables defining road condition have been reviewed, we can look at the effect of external factors in the condition of the road:

- Temperature: in general one could say that the lower the temperature, the worse the consequences for road condition. Extreme low temperatures affect negatively structural strength and accelerate the creation of cracks. Besides, low temperatures together with road circumstances (in this case snow) affect the road friction coefficient negatively, increasing the chances of accidents. Since structural strength influences the other road condition variables in an important way, one could say that extreme low temperatures are the external factor with the worse effect in network condition. One that makes the problems of road administration in extreme cold climate countries such as Finland very different from the problems faced in the Netherlands or elsewhere.
- Moisture and rain: these have also a rather negative effect on the road condition. The more moisture is on the roads, combined with extreme low temperatures, the faster the process of deterioration of structural strength and creation of cracks. Rain also has a temporal effect on the safety aspect, as temperature has it through snow. In this case, if it rains and there are problems of ruts in the network, the chances of aquaplaning accidents increase.
- Traffic: as could be expected, traffic understood as use of the road, has a degrading effect on the condition of the road. Heavy traffic in particular weakens structural strength and accelerates deformation and the creation of ruts, while traffic in general affects negatively the road texture, and accelerates the creation of ruts and cracks.

Finally, we can explain the outcomes or performance indicators of the system:

- *Level of service*: the level of service offered to users is the result of the combination of purely physical road condition (more pavements related) and the quality of routine or winter maintenance.
- *Societal costs -number of accidents*: apart from the direct cost of individual users, there are societal costs, which in this case are considered to be mainly accidents. We can distinguish two main causes of accidents: loose of vehicle control (where aquaplaning is the cause during summer and too little road friction the cause in winter) and traffic speed variation (because if there are ruts, people start breaking).
- *Environmental effects*: the three main effects mapped here are sound, pollution due to usage of fuel, and pollution from the extra wear and tear of tires.
- *Users' cost*: in users' cost we distinguish the direct costs they have due to the degrading of their vehicle (i.e. replacement of tires, reparation of vehicle mechanisms) -which are reduced the better the condition of the road- , their costs due to additional fuel consumption and the indirect costs of travel time.
- *Users' satisfaction*: the satisfaction of users is not only determined by their costs but also by the comfort of the ride they experience. Their satisfaction not always directly relate to the overall road condition. Research is still going on about which aspects of road condition matter the most for the experience road user's have of the road.

This last aspect, users' satisfaction, deserves further discussion, since is till certain extent a contra intuitive result. The fact that road condition does not directly correlate with users experience rings a bell if decisions are to be made whether to make users opinion decisive of contractors' payment, in the new maintenance contracts. In the previous graphic it can already be seen how some aspects or road condition variables that ensure a safer ride, affect negatively the comfortability of the ride and consequently the perception of the road user. The following section shows other possible problematic aspects that may arise, if drivers' experience of the road is assigned relatively more weight than other performance indicators.

Efficiency versus users' satisfaction: the battle of two public values

Figure 3.25 shows the trade-off between two public values, the efficient use of public funds and the focus on users' satisfaction. While society in general demand an efficient use of funds, which means that the threshold value of coverage needs to be higher (percentage of coverage is the measure of efficiency of the pavement action, it measures how many metres are in poor condition of the total section repaired) this would affect users' satisfaction negatively in two ways:

- To increase the percentage of coverage it is necessary to make the total length of the section to be repaired shorter, which will affect negatively the homogeneity of the road network and therefore will make the ride less comfortable for users.

- An alternative to shortening the length of the section to be repaired is to wait until more problems are shown on the section, which makes that users' experience the problem (i.e. cracks or ruts) more times than usual and also affects negatively their satisfaction.

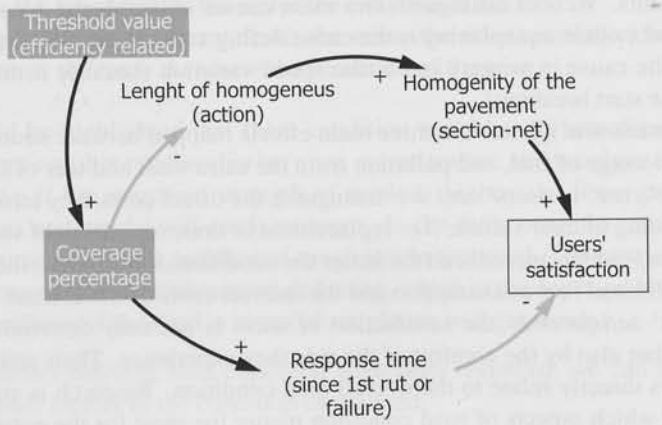


Figure 3.25: *CLD of the trade-off between efficiency and user's satisfaction*

The diagram in Figure 3.25 shows how top quality it is frequently too expensive to be achieved. It also pictures an important conflict of values or trade-off that road agencies may be transferring to private companies, in the new contracts. This conflict becomes crucial if new contracts are to make these private companies responsible for entire road networks and judge them on the basis of mainly users' satisfaction. Before this transfer of responsibilities is carried out, it seems necessary to establish within the agency; first, which thresholds are reachable and could ever be required from contractors; and second, which historic levels of the threshold values have shown to be optimal in efficiency and users' satisfaction terms.

The conflicts, concerning users' perception, reviewed in the last two sections point out the need of a thorough research and discussion on which should be the maximum weight assigned to users' satisfaction -comparatively with other performance indicators- to avoid inefficient use of public resources -like gold plating- or unfair payment or retribution to contractors' effort and good work. Users' opinion could be also a double side sword, as explained by Äijö (2006) from all indicators of road condition, this is the most subjective and easy to be influenced, through marketing campaigns and the like. So if too much weight is given to this factor, the road agency could end up either with public resources being used inefficient or in the worse of the cases, with "satisfied users" but "underground" a road network in very poor condition.

Figure 3.26 as the previous one, goes on picturing factors that though are not so directly related to the physical condition of the road, do influence the decisions made

about periodic maintenance.

3.4.4 The wider environment of the periodic maintenance system: the influence of procurement strategies

As mentioned before, Figure 3.26 shows the impact of two additional policies in the performance of the system. These two policies are, first the tendering and procurement strategy and second, the safety related policy.
As can be seen in the CLD, the actual road condition (i.e. structural strength) in combination with the desired road condition (which is a value set probably by external actors such as the ministry of transport) define the upgrade needed or the magnitude of the corrective action that needs to be implemented. Then, one could assume that the bigger the need, the more budget will become available for the action. However, this does not directly translate in an improvement of the structural strength or at least, not directly into one proportional to the budget invested. Here the influence of the procurement policy comes into play. Though one could expect that if more budget is offered for a particular work (in periodic maintenance) the more the effort the contractor will put on the project and the higher the quality of the bitumen mix and work he realizes; there are other aspects that influence the level of effort he will invest in that project. These other aspects are:

- *Contractors internal cost of upgrading*: the more expensive is for the contractor any additional point of quality and/or effort, the more he will tend to save effort and provide a lower quality solution.
- *Profit seeking versus reputation building*: if the contractor selected is more driven by the desire of increasing its profit than of building a reputation, the most probable is that he will invest least possible effort in the work. The attitude of the contractor is affected by the incentives included in the contract as well as in the long term by their position in the market or market power.
- *Points assigned to quality in contractors selection process*: if more importance is given to quality, one could expect that there are more chances that the contractor selected has the capability to realize a better quality job. Besides he is to some extent legally more forced to provide the service described in the tender, which includes quality aspects, and which are normally not covered in price only selections.

Nowadays competition for periodic maintenance works is mainly price driven, since this is the overarching criterion for the selection of the winner contractor. Paradoxically the asphalt business -due to its technical characteristics- is also characterized by quasi-monopolistic competition levels that keep prices high. These two factors leave to contractors few incentives to work hard for a better reputation. The new integral maintenance contracts may improve the situation in this area, since the idea is to consider more quality aspects in the selection of contractors. The inclusion of additional

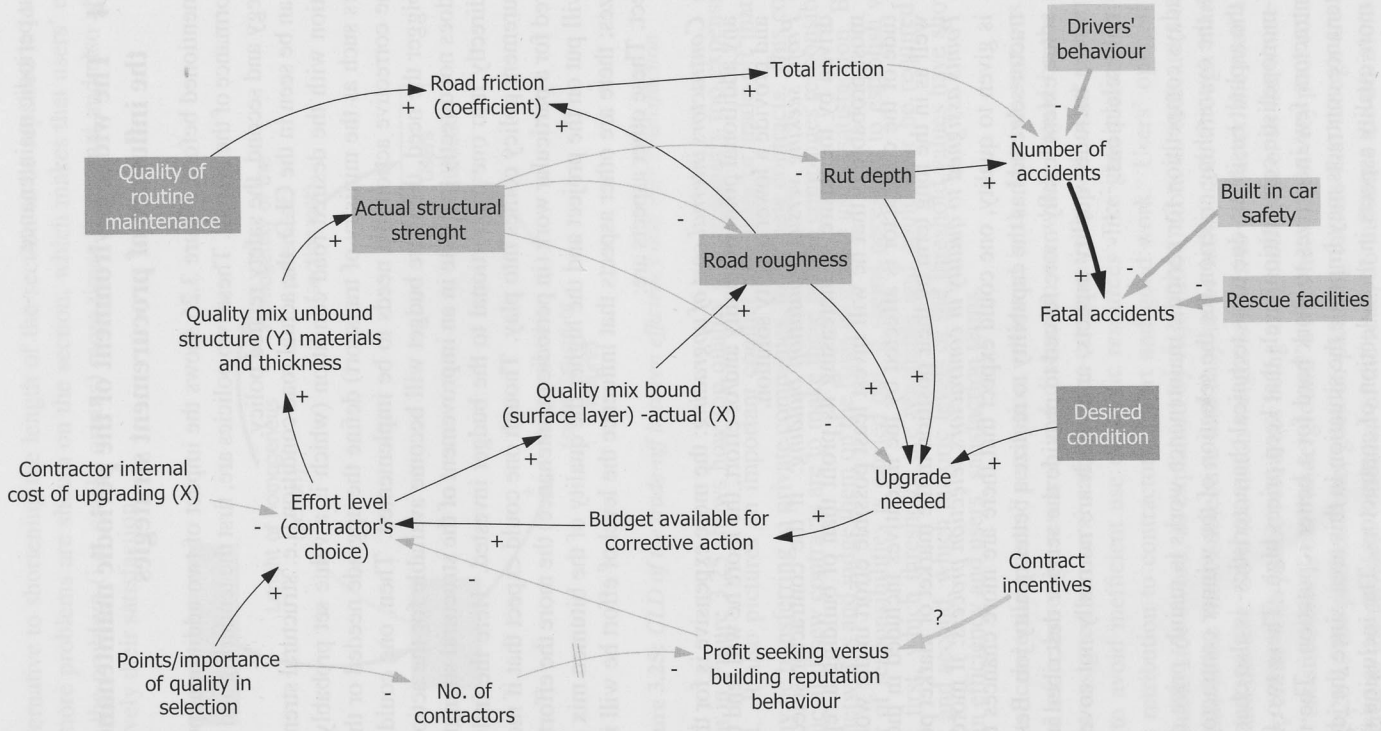


Figure 3.26: *Mapping other external variables*

tasks than only asphalt related works, - like routine maintenance and operation task- will also mean that different companies take part in the competition and the status quo of the asphalt business is disturbed.

Now, referring to the safety related policy, we discover that though the number of accidents in general is very dependent on the road condition; the number of fatal accidents it is not necessarily that dependent; since one could prevent that normal accidents become fatal by increasing the built-in safety in cars or by improving the availability and quality of rescue services.

In this way we could see how the merely physical problem of road condition correlates with aspects in a wider scale and therefore solutions for the problem can be also achieved by cooperating with the instances in charge of these other policies and by opening in general a wider discussion process in society.

Innovative maintenance contracts appear to go along these lines. Since they will probably include not only routine and periodic maintenance tasks, but also operation tasks like incidental traffic and safety services, they are expected to promote more coordination between the responsible of road maintenance and other agents like the police and first-aid teams; all aiming at reducing the number of fatal accidents.

3.4.5 Opportunities and threats: an illustration

As already mentioned before this section aims at presenting an illustration of the many trade-offs and decisions that are nowadays realized by public infrastructure operators and which may be transferred to private contractors if innovative contracting practices become the norm.

First, the system analysis realized -through CLDs- shows that important trade-offs or practical dilemmas concerning the management (i.e. operation and maintenance) of existing road networks are:

- First, related to winter tire regulation (i.e. how heavy is the grip/skid allowed to drivers in their tires); two opposite effects this regulation has on safety or number of accidents were discovered. On the one hand, it prevents one type of accidents during the winter; but on the other, it accelerates the process of creation of ruts, causing more hydroplaning accidents in the summer. Hence the need to weight both effects and research into the optimal range of values that could reduce both kind of accidents and ensure a more cost effective maintenance of the road network.
- Further, when analyzing other factors that could reduce the number of accidents during winter, it was found that alternatives are to improve the quality of winter (routine) maintenance or macro texture of the road, so as to raise the friction coefficient and increase vehicle control. Important questions that arose here are which could be the maximum levels of these different variables and what their behaviour in terms of cost is. Could the authority better invest extra in winter

maintenance actions what is now invested in the reparation of ruts and achieve in this way a much better performance in terms of safety and costs?
- Second, related to users' satisfaction, two important tensions were found. The first one is between road condition and users' satisfaction, since a better condition does not directly relate to more satisfaction. The second is between two public values, the efficient use of public funds and the focus on users' satisfaction.

These are only meant as an example of the kind of operational dilemmas faced by public network administrators; in this case especially relevant for authorities in charge of road networks exposed to extreme weather conditions. Other dilemmas, faced for instance by road authorities in charge of highly congested road networks are (Demkes et al. 2007):

- To choose for a reduction in the inconveniences caused to road users (which minimizes societal costs) by promoting the realization of maintenance works during nighttimes or weekends; or to choose for lower costs of maintenance works (which minimize the authority own costs).
- To choose for the most convenient moment for the realization of maintenance (realizing maintenance works precisely when needed); or for a good spread of the workload for the convenience of own personnel (reducing the chance of under or overload).

Besides, there are a number of operational dilemmas valid for network administrators under all climate or traffic conditions, such as:

- To choose for faster and cheaper construction of roads or for reduction of total life cycle costs or total costs of ownership.
- To choose for extra investing on projects in order to become a society wide example in the area of sustainability and respect for the environment, or focus simply on fulfilling the minimum legal obligations.

All the trade-offs need further thinking and society wide discussion if the idea is to transfer them to private agents. The issue of users' satisfaction deserves special attention since there seems to be a trend to make indicators related with it more decisive for the payment received by contractors.

Second, by expanding the boundaries of the system, it has been analysed how the management of pavements as subsystem and the choices taken within it, influence and are influenced in return by choices taken in other subsystems, such as the procurement one. Based on these findings, a number of opportunities and threats or challenges posed by innovative contracting practices can be formulated. On the one hand, the new maintenance contracts being discussed and put into practice recently in some countries, do pose some risks, mainly derived from transferring decision rights and

many practical dilemmas to private contractors with clear different interests than the public road agency. On the other hand, by reviewing the wider context of such contracting practices, it appears that as these new contracts are characterized not only by longer term contracts and bigger networks but also by more quality based selection of contractors and the inclusion of operation tasks; could improve indeed the performance of the road network by:

- Causing a different attitude in the traditional asphalt contractors
- Ensuring more competition in the asphalt market or enlarging the pool of contractors that could compete for such new contracts. The asphalt market is characterized nowadays in many countries for quasi-monopolistic levels of competition that keep prices rather high.
- Including incidental traffic and safety services that promote more coordination between the responsible of road maintenance and other agents like the police and first-aid teams; all aiming at reducing the number of fatal accidents.

Before transferring more decision power and responsibilities to private contractors; policy makers in road agencies and other governmental bodies related, need to invest further thinking and discussion on the topic. Some examples of issues that require further effort are:

- Related to the trade-off between winter tire regulation and the quality of winter maintenance, specifying clear thresholds and ranges in contracts. This is necessary in order to avoid future conflicts and more importantly continuous impoverishment of the road network condition.
- Concerning users' satisfaction: establishing reachable values and maximum levels ever expected from contractors, and defining a upper limit for the weight to be assigned to this indicator in comparison with other performance indicators more directly correlated with road condition and contractors' effort.
- Realizing further numeric analysis of the factors reviewed in this work, and/or others of similar nature, deemed relevant within a particular national context (given the concrete climate conditions). Such analysis will assist public authorities in the designing of a fair payment mechanism and/or distribution of contract incentives that guarantee the sustainability of the sector and the road network.

In addition, if users are to become more important in judging the performance of contractors and of the road infrastructure in general; they also need to be more informed about what their preferences mean in practical terms and how they may translate in conflicting values or choices for the operators and managers of the network.

3.5 Concluding remarks

The formal analysis of innovative contracting practices -conducted making use of system dynamics techniques- proved useful for depicting a clear problem definition -the tension between flexibility and safeguarding of public values- and for understanding the interdependencies between contracting practices. The main message is that authorities need to be careful about the results expected from the application of innovative contracting practices. Nevertheless, in order to draw more concrete conclusions about the pros and cons of applying these new contracting practices and about preconditions or requirements for success; further research is needed. First, research on how different road authorities have dealt in practice with this tension or trade-off, and second, realization of experimental study or research of alternative solutions to this dilemma that contributes with concrete advice or guidelines about how to build the right incentives in this new type of contracts. In order to realize such research an instrument or tool may be needed.

Following, the analysis of the road management system and the exploration -through CLDs- of the different factors that affect the performance of the system, proved also fruitfuil in giving a clear indication or illustration of the many practical dilemmas now solved in a daily basis by public authorities. The main message of this analytical exercise is not exactly focused on the concrete trade-offs depicted here, but rather create awareness about the many operational dilemmas that are relized by public network operators and that have a great impact on the performance of the system, daily experienced by road users. The findings of this exercise advocate for a serious and systematic discussion of such practical dilemmas before they are fully transferred to private contractors; before innovative contracting practices become the norm and goverments loose direct control on the daily decision making. Analysis and systematic discussion of these practical dilemmas -which are definetely not to dissapear but to be taken over by actors with different interests- is a critical element for the preparation and transition period to come. Only based on such understanding, can proper incentives be built into future contracts and can authorities draft the necessary enforcement mechanisms to ensure the safeguarding of public values.

Discussion on this level does not appear to be taking place. The following excerpt from a report of the Dutch Road Authority (RWS), translated from Dutch, confirm this view:

> A problem often mentioned concerning the political argumentation about public values is the level of abstraction on which this discussion takes place. Such high abstraction level is indeed important for the fundamental discussion about public or private roles, but it does overlook very practical trade-offs and dilemmas that the network administrator daily faces. The management of a road network is a multifaceted working field where many social, juridical, organizational and financial aspects influence each other. During the planning and execution of activities the network oper-

ator has to make many choices . With the execution of different duties the network administrator aims at fulfilling the needs of the road user. The choices that the network administrator makes in this will be partly dependent on the type of network that he manages (Demkes et al. 2007).

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Chapter 4

Cross-national comparison of innovative contracting practices

4.1 Introduction

This chapter aims at presenting a cross-national comparison of the Finnish, the Dutch and the Spanish models of procurement and their respective developmental paths: from the traditional setting where many of the works were still done in-house, to the present mix of innovative practices in the three markets: capital projects, routine and periodic maintenance.

It presents the empirical results from the comparative study realized through field research in Finland, the Netherlands and Spain. The answers to the research questions for both units of the case study research will be presented; the national road procurement strategy (NPS) and particular innovative project selected per country.

The chapter starts with a description of national procurement models in place followed by a summary of the findings from three PPP projects studied in further detail. It continues with the presentation of a cross-national comparative analysis of the advance in the use of innovative contracting practices and an overview of the effects delivered by these practices so far. To place these developments in perspective, empirical findings about the reform processes followed by these three countries are presented. Finally, the most important challenges ahead for each of these three countries are presented.

4.2 National procurement strategies

The following subsections present the general advance in the use of innovative contracts in each of the three countries in three different road markets: construction of

capital projects, routine maintenance and periodic maintenance. This section aims at presenting a comprehensive overview of the use of innovative contracting practices per country, from which is possible to draft particular national trends and characteristics of each national procurement model. A comparison (cross-national comparative analysis) between countries and an estimation of their relative level of advance will be presented in Section 4.4.

4.2.1 The Finnish procurement model

The situation in Finland is a combination of different scenarios, depending on the specific road market one describes. The following subsections explain these differences.

Capital investments

In terms of the use of private financing, integrated project delivery methods, performance monitoring (i.e. use of more outcome-oriented indicators), long-term contracts and quality-based contractor selection; the main characteristics of the Finnish capital procurement model are:

(1) Alternative financing: as previously explained only two PPP projects have been realized and so far there are plans to apply the DBFM project delivery method to new projects. The experience in DBFM projects -with only two projects implemented- is still quite limited and consequently transaction costs remain rather high. Given the positions of the actors now, it is not expected in the short term a significant increase in the use of this model. However, the positive aspects of this obstacle, is that Finnra remains quite open and testing many other integrated models.

(2) Integration: extensive use of integrated DB delivery methods, 60% of projects (value in euro). They have arrived to a good and quite stable DB model, which is implemented for more than 60% of the projects and since 2006 this model is also applied to small projects following a simplified procedure. The use of further integrated models like DBFM has not advanced much but this has been the result of a conscious choice. The routine maintenance component of these contracts makes them somehow problematic, because this kind of maintenance requires bigger areas instead of isolated road sections to be more cost-effective. However, it could be argued that since contractors remain responsible only till construction and not for the whole useful life of the asset, the main incentive to optimize design to achieve significant savings in the total life cycle costs is missing. Which savings could be most significant, is not yet known. Right now the major advantage of DB projects is the shorter delivery time compared to the traditional DBB.

(3) Performance monitoring: further development is expected in the use of performance or outcome oriented indicators, since their use has been limited until now -most of requirements in contracts are still of a technical or physical nature- the maximum advance towards outcome indicators (instead of input oriented) has recently begun with the introduction of functional indicators. An exception is the last PPP project (E-18) where performance and payments are based on availability of the road, a much more outcome-oriented indicator than in all other capital projects.

(4) Contract term: the contractual relationship in DB contracts last relatively short, from contract award until delivery of the project. There may be guarantees for certain elements of the project, but as a different contractor will take care of periodic maintenance of this road section and/or project, the contractor that took care of construction cannot be hold directly responsible after delivery. The maximum length for a contract so far has been the one of the E-18 project, for a total of 25 years.

(5) Contractor selection: all capital projects are awarded on the basis of price and quality, with a weight of 75 and 25% respectively.

Routine maintenance

All routine maintenance activities in Finland are nowadays outsourced making use of the so called Service Area Contracts, a standard contracting model developed in 2001 when the routine maintenance market as a whole was created and 95 well defined areas where delimited as well as it was planned a clear tendering cycle approximately 22 areas per year. These contracts are characterized by:

(1) Direct government financing.

(2) Very integrated contracts, task-wise as all activities except lighting are included.

(3) Output oriented indicators, as contractors performance is judged in terms of response time to handle deviations and/or incidents (2 to 8 hours), depth of snow layer (residual snow), road friction coefficient and salt usage (for which there is a maximum to keep the impact on the environment as low as possible). The acceptable values for all these variables vary according to the level of service agreed or the so called "Winter Maintenance Class" to which a specific road section pertains to. In Finland there are 5 different classes. The payment system is a hybrid system where 75% is on lump basis and 25% on schedule of rates basis or unit costs. Besides these payments contractors may receive a bonus based on users' satisfaction, which is clear an outcome oriented indicator. The customer satisfaction bonus started to be awarded annually from 2005 and the amount of the bonus varies between 0 and 1.6% of the annual cost of the contract. This

Table 4.1: *Overview of Finnish procurement model (end 2006)*

	Capital investments	Periodic maintenance	Routine maintenance
ALTERNATIVE FINANCING	2 PPP Projects No more projects planned due to opposition of Minister of Finance	100 % GOVERNMENT	100 % GOVERNMENT
INTEGRATION	50% PROJECTS DB Simplified "DB" procedure for small projects Plans: 1) Increase in "value" tendered by combining: 2) A number of small projects 3) More life cycle phases	Not real integration until now: - Design (mix of bitumen's) outsourced but not integrated - Starting integration: bound + unbound layers	Service areas contracts contains all activities except road lighting maintenance, road marking and pump station maintenance
PERFORMANCE MONITORING	Still focused on "technical" or "physical" aspects, especially for bridges Last PPP: Availability based payment	Very traditional (i.e. inmediate cheking after work delivery) Pilot project of a group of concrete roads	Performance is mainly: - Response time - Friction coefficients - Salt use - Bonus: users' satisfaction
	More and more hiring of consultants for "spot checking" and quality monitoring		
CONTRACT TERM	Last PPP (25 years)	Aiming to have more "condition responsibilities" contracts of 5 years (now only 10-30% of the cases of "reconstruction")	7 years
CONTRACTOR SELECTION	75 % Price 25 % Quality	100 % Price	75% Price 25% Quality

bonus is based on 4 to 6 evaluation criteria: two are based on results from a special survey of customer satisfaction, two are estimated by controllers (one relating to the success of winter maintenance and one to the success of summer maintenance) and the additional two represent the new concept of bonus due to road user satisfaction, which is taken from the direct feedback from customers calling to Finnra service line and aims to stimulate contractors to think of "road users" as their clients. The assessment of supervisors, especially with regard to winter maintenance, is based on information available on the area contract monitoring system Aura. Customer satisfaction criteria are not taking into account when calculating the sanctions. Sanctions are based -as shown on Figure 4.1- on the requirements set by the client (e.g. winter maintenance service levels and contractor's compliance with own quality control system).

(4) Quality based selection, 25% quality, 75% price. The effective weight of quality

is however farther less and the curve that determines this weight is adjusted depending on the trade-off quality versus ensuring more competition/competitors, that each year is made. Some contractors believe however that this was not the best choice in the beginning, because this allowed for the newly created FRE a relative strong competitive advantage, given that they were the only ones with experience in the sector.

(5) Every time longer term contracts; first 3, then 5 and now 7 years.

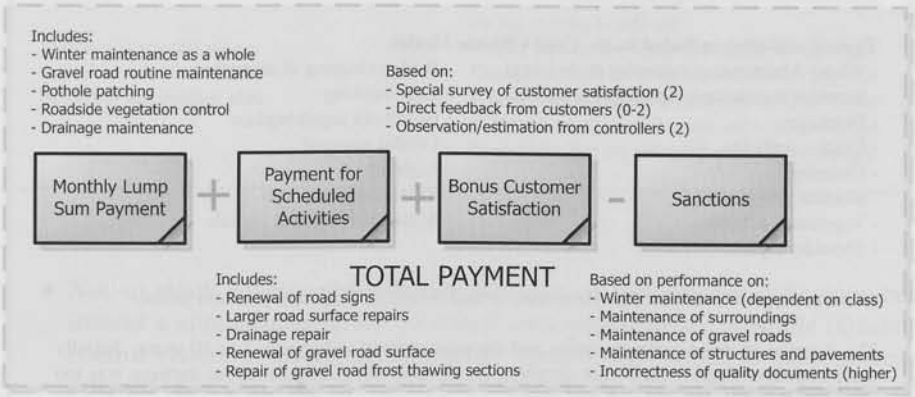

Figure 4.1: *Finnra payment system for routine maintenance (service area contracts)*

In general terms it could be said that Finland makes use of the so called "Cold Climate Model" as it was described Pakkala et al. (2007) in his international benchmarking study (refer to Table 4.2).

The outsourcing of routine maintenance in Finland appears to have reached a mature stage where all innovative contracting dimensions have been combined. Nevertheless, this sector could be revolutionalized if authorities decide to ingrate routine and periodic maintenance in one single contract.

Periodic maintenance

On the contrary, periodic maintenance it is still at the beginning of the reform, with traditional contracts (i.e. prescriptive contracts for specific works in a particular road section awarded to the lowest bid) being used. The difference is that more outsourcing -of design and planning tasks- is taking place than before the institutional reform. The idea of contracting in a larger scale -a network instead of specific road sections- and for a longer term has been tested in a recent pilot project in the Häme region. See Table 4.3. This is in fact the sector expected to change the most in the following years.

Table 4.2: *Description of cold climate model for routine maintenance*

Cold Climate Model
The "**Cold Climate Model**" is the outsourcing of basically all routine maintenance activities usually included in an area based network. The main reasons for calling this the "**Cold Climate Model**" is due to the commonality between the northern located countries and the diffieulty to include periodic maintenance activities (especially resurfacing) in one contract. The reasons why periodic maintenance is not included can be attributed to the short mild season and because the markets in the northern countries are quite small and well established. Sometimes small capital investment projects can make part of the contract and prices are usually agreed upon or else it can be tendered as a separate contract.
Typical activities included in the Cold Climate Model: - Winter Maintenance (plowing & de-icing) - Summer maintenance (potholes & cracks) - Drainage - Cracks, potholes - Cleaning - Routine gravel road - Vegetation & trash - Shoulder repair - Bridge cleaning & inspection - Line marking - Guard rail repair/replace - Graffiti removal - Lighting - Emergency response - Sometimes signs & signals
Contract type: Could be either lump sum, or and hybrid of lump sum plus unit prices.
The duration of these contracts varies and the present trend is between 7 to 10 years. Initially these contracts began with 3 year duration, but soon it was realized that the duration was too short and shifted toward 5 years and more.
Service provider selection criteria vary.
The countries using this model are the Canadian Provinces of Alberta, B.C. and Ontario, Finland, Norway, Sweden, Florida DOT (FDOT), New Zealand, and the Netherlands.
Source: Pakkala et al. (2007)

Main characteristics of the Finnish model

Finland overall procurement strategy can be characterized by:

- Very integrated especially task-wise in what refers to routine maintenance contracts and life cycle wise in the market of capital investments 60% or more of the projects are being realized as DB.
- Nevertheless, rather traditional in periodic maintenance.
- Very high levels of outsourcing, 100% of works at all levels are outsourced, and design is already being outsourced in more than 60%.

Table 4.3: *Example of an innovative case: pilot project for the maintenance of a network of concrete roads*

Häme Region	
Pilot project: periodic maintenance of a network of concrete roads	
Location of the Project:	Häme Region
Deadline for submission of offers:	30.01.2006
Activities of the Project:	Paving and rehabilitation of a network of concrete roads
Contract term:	10 years.
Payment:	Lump sum. Payments are realized each summer for the activities realized
Functional specifications:	Traffic Safety and good condition of the road. These conditions will be checked twice per year
Selection and quality plan:	in their offer contractors have shown their "plans of how to do it", and they are allowed to change these plans, but the price offered cannot change.

- Not so much advance towards real outcome or performance indicators, but instead a combination of the so called own responsibility principle (Quality control system proposed by contractors themselves) -which is more process oriented- and checking of rather physical outputs -through spot checking of road friction coefficients for example.

Other main characteristics of the Finnish procurement model are:

- The reform and the particular procurement model chosen are based on a good and close relationship with the industry, like it is also the case of New Zealand.
- Guided or administered by a very small road agency with strong leadership and a very clear and operational plan of the objectives to be achieved by all levels.
- The most important driver for the implementation of innovative procurement models seems to be the need to reduce the government size and therefore the main philosophy has been to implement practices that are as little demanding for the personnel of the agency as possible.

4.2.2 Spanish procurement model

The situation in Spain is a combination of different scenarios, depending on the market and to some extent on the region of the country. As explained before the study of the Spanish case included an extra unit of analysis, the autonomous community of the Basque Country, more specifically the Foral Deputation of Gipuzkoa, San Sebastián.

Interviews were also realized in Madrid -to national authorities and large construction and consultancy companies- to double check the tendencies observed in San Sebastián. As a result of this double research effort, it is possible to present a unified analysis of the Spanish procurement model (see Table 4.4). If significant differences were recorded between the national and the regional situation, these are going to be highlighted.

Table 4.4: *Overview of Spanish procurement model (beginning 2007)*

	Capital investments	**Periodic maintenance**	**Routine maintenance**
ALTERNATIVE FINANCING	Concessions and toll roads since the 70s. Stopped in 1982 and new model in use since 1996. Shadow toll being more used since 1996	100% GOVERNMENT	100% GOVERNMENT
		Starting to implement (June 2007) integrated contracts that use private financing - shadow toll & performance based contracts	
INTEGRATION	DBB projects DB used in the 80s and 90s but poor results, now used only for small projects	June 2007 first contract that integrate periodic with routine, was opened to tender Other contracts - traditional	Integrated (routine) maintenance service contracts since 1998
PERFORMANCE MONITORING	No significant advance in this area. For DBB: checking takes place mainly in terms of effort and compliance with prescribed methods	Traditional prescriptive indicators (technical requirements), compliance with detailed "normatives"	Some performance related indicators but not determining payment Prescribed frequencies instead of functional requirements
		The most recent concessions do include performance/quality indicators that determine payment	
CONTRACT TERM	Maximum length concessions in law: 75 years	2 years guarantee	2+2 years
		New concession contracts: 19 years	
CONTRACTOR SELECTION	40% Price 60% Quality (e.g. technical plan and relevant experience built the last 5 years)	30-50% Price (highest "saving" offered)	40% Price 60% Quality
		New concession contracts: 50% Quality 3 envelopes	

Capital investments

(1) Alternative financing: long tradition of direct toll and private financing. Spain counts with a well-established concession model that started in the late 60s. From all these first concessions the only one officially handed back to government is the A-8 (Bilbao-Behovia). The concession period of all the others has been extended in consideration to the low traffic problem. It is important to mention that many of the first concessionaires ended up in bankruptcy. The gov-

ernment tried to solve the situation by buying many of them and grouping them into a national enterprise that existed until 2003 when it was privatized again and sold to Sacyr. Recently there is also some "trend following" behaviour or inspiration been found in the Anglo-Saxon model from where the shadow toll method has been borrowed. More and more projects are making use of the shadow toll but this is not expected to become the overruling model. Direct toll projects are also being started.

(2) Integration: Wide spread use of the traditional DBB project delivery method, with still representative number of people within the government organization realizing designing tasks, mainly for small projects. The design and project management of large projects is normally outsourced. DB project delivery method was used in the 80s and 90s. Some of the variations implemented was the "German DB model". In the last years it is used less and less and mainly in small projects- contrarily to what is happening in Finland and the Netherlands. The experience was not good, probably due to the particular way it was implemented that gave perverse incentives to contractors, who tried to minimize construction costs or shorten the delivery time (in the case of the German model) at the expense of quality. The problem was partly that it was not really a lump sum contract but payments were actually unit dependent and many design changes were allowed. Up to 20% increase in costs was allowed without special permission of the council of ministers.

(3) Performance monitoring: as expected buy the wide spread use of DBB contracts, the monitoring of contractors is still realized in a rather traditional way, by supervising contractors effort and compliance with prescribed processes and/or frequencies in the case of contracts that also integrate maintenance tasks. The limited use of DB contracts seems also to point towards little design freedom being granted to contractors. Nevertheless, as explained by contractors and consultants, it is difficult to say in reality how much freedom they have, since "changes" are allowed and authorities are open to discuss modifications. In any case, it is still true that the government authority has to approve these changes.

(4) Contract term: Spain records the longer-term contracts from the three countries studied, with concessions of up to 65 years.

(5) Contractor selection: the weight of quality of 60% aspects is relatively high, in comparison with the weight give to these aspects in Finland and the Netherlands.

Periodic maintenance

Like in Finland, periodic maintenance -except from new contracts- remains rather traditional. The advance towards performance or outcome Indicators has been limited and contracts are still defined in terms of technical requirements. The so called

"Quality Indicators" are still more input than outcome oriented and the intention is to control them by using the same system than in Finland, spot checking combined with contractors' own records. Besides the guarantees offered by contractors are limited to two years. Nevertheless, as in capital projects the weight of quality related aspects in the selection of the winner contractor is relatively high, as price can only weight up to a maximum of 50%.

A new kind of contracts has been developed by the Ministry (Ministerio de Fomento in Spanish) that besides including significant reconstruction works it also integrates routine and periodic maintenance tasks for a 19 years period. This is a rather ambitious and innovative delivery method since not only integrates all these activities, but it also makes use of alternative financing (i.e. UK shadow toll model) and performance indicators. The characteristics of this model will be discussed in Section 4.3 where the most innovative project delivery methods of each country will be discussed.

Routine Maintenance

Like in the rest of the country, maintenance is outsourced in San Sebastián since 1998 using integrated service contracts. The main differences of these contracts versus the ones used in Finland seem to be:

- More focus on safety and management of incidents/accidents.
- Performance indicators included in the contract do not directly affect the payment realized to the contractor.
- Payment is not only lump sum, but a hybrid of fixed monthly fees -to cover the costs installed capacity for the operation and maintenance of the area- with unit prices for certain tasks.
- Contract duration is much shorter (i.e. two initial years plus two additional ones if contractor shows good performance) and again the weight of quality aspects is rather high.

Spain appears to be a pioneer in the introduction of private financing to maintenance, either in the form of shadow tolls or direct tolls, as it is the case of the last concession in San Sebastián (see Table 4.5).

Main characteristics of the Spanish model

Spain overall procurement strategy can be characterized by:

- Very long tradition of toll roads. From the four trends in procurement, the Spanish model (i.e. capital projects) could be characterized mainly by its experience in private financing -first with direct tolls and lately with shadow tolls- and very long-term contracts; since the early 70s.

- Integration meanwhile does not seem that important, with some experiences in the 80s and 90s using DB that did not bring good results. Nevertheless they seem pioneers in integrating safety related tasks into their integral maintenance contracts.
- Performance Indicators are -like in Finland- the trend less developed.
- In routine maintenance there has been -quite similar than in Finland- advance mainly towards integration of tasks and areas but contract terms have remained surprisingly rather short (i.e. four years). Meanwhile periodic maintenance -like in Finland- remains rather traditional.
- As it could have been expected, the last innovation of Spain are the maintenance contracts that combine periodic and routine maintenance tasks that are different than pilot projects in other countries, for their private financing component. Quite long term contracts: concessions of up to 65 years, but meanwhile standard maintenance contracts are just 4 years long.
- An additional aspect, concerning contractor selection criteria, shows a significant advance of the Spanish model in considering quality aspects. Except periodic maintenance contracts, quality weights in all contracts more than 30%; specially in the Gipuzkoa province, quality related aspects score significantly for the final decision.

Characteristics of the Spanish procurement model are:

- Variety of experiences- due to decentralization-, not only the Ministry has the leading, sometimes provincial governments try out innovative contracts first. Nevertheless all road authorities keep relationships with each other, are good organized and exchange experiences not only at the national level but also through organizations like the World Association of Road Directors (PIARC) and Carreteros.
- Experienced client (Ministry and regional governments) that is also fairly open to the discussion of changes in design solutions.
- Very competitive -but not necessarily efficient- market in the area of capital projects, especially concessions and PPP projects. International companies apparently do not dare that often to compete in Spain, while Spanish companies compete in many foreign markets (e.g. French and Latin American).
- Recently there is also some trend following behaviour or inspiration been found in the Anglo-Saxon model, from where the shadow toll method has been borrowed. Nevertheless, in general, Spain seems much less concerned than Finland or the Netherlands in following foreign or Anglo-Saxon best practices, but actually find pride in designing new schemes themselves.

- The main driver for the implementation of most innovative contracts cited was the financial deficit that together with the urgent need to update the network makes large investments from private agents, necessary. Innovation did not seem to be in their list of goals. Apart from the main financial advantage, other positive effects expected from the innovative contracts are the breaking of the status quo in the system of agreements and market quotas between contractors; especially in the market of raw materials and routine maintenance.

In general terms, the Spanish procurement model could be defined as:

- More implementation oriented than the Netherlands; i.e. no mention of pilot projects, less discussion and consensus building oriented.
- A lesser amount of political discourse than both Finland and the Netherlands; i.e. no mention about innovation as the driver but openly about financial deficit.
- More independent from Anglo-Saxon examples and more French like. Even though there are some important differences in the legal framework; i.e. far more decentralized and varied model than the French and with provinces sometimes leading the development of innovative practices.

Three features of the procurement model of San Sebastián that appear to be different from the central level (Ministry case) and from the situation in other provinces are:

- The existence of a public concessionaire -or public company (Bidegui)- that takes care not only of the maintenance but also of the updating and expansion of the A-8 highway and related sections. This represents an additional actor in the procurement system. One that is rather interesting to be studied. Although it has public ownership, it is supposed to perform more like a company and has personnel with no previous experience in the government body. In the future, more and more responsibilities are expected to be acquired by this institutional figure. See Table 4.5.
- A relatively closed market in pavements, characterized by quasi-monopolistic behaviour of the two leading companies (i.e. Campezo and Orza).
- A desire and tendency to introduce direct tolls to more road sections; while at the central level shadow toll contracts appear to be gaining popularity.

Table 4.5: *A-8 Concession, Basque Country*

A-8 concession, Basque Country, Spain	
Concession location:	Basque Country, Gipuzkoa foral deputation
Beginning of concession:	March 2003
Historical background:	- At first all roads were under the jurisdiction of the deputations (Gipuzkoa, Biskaia and Alava), there were no roads under the jurisdiction of the central government or the autonomous Basque government. - Since 1936 during the civil war and under Franco's government there was a process of centralization and the power and responsibility of all main roads (red principal) of all Basque provinces were transferred to the Ministry of Public Works. - Later in 1982 -when the Statute of Autonomy came into effect- these road networks were given back to Autonomics Governments, in this case the Basque Government. Autonomic governments then transferred some of these roads to the deputations of each province. In the case of the Basque country, the Basque government transferred in 1985 all roads to each deputation.
Concession antecedents:	- The first concession to finish -the A-8 highway from Bilbao to Behobia with Europistas- was under the jurisdiction of Gipuzkoa and Biskaia. It is therefore here were it has taken place the first experience (in Spain) of handing back a concession to the public authority, after 35 years (started in March 1968). - Political circumstances were different from the moment the concession was given and the now responsible provinces had to decide what to do with this new road section under their jurisdiction.
Creation and role of public concessionaires:	- The solution given by both provinces was -instead of extend the concession period or open the road to free access- to keep the toll and create Public Concessionaires to administer these sections. - Both public concessionaires have the purpose -entrusted by the foral deputations- to realize studies and projects; to build, give maintenance, finance and operate -by themselves or through outsourcing- the road network. Their juristiction refers especially to the management and operation of the A-8 Highway in the sections that cross their historical territories. So they embark not only on maintenance tasks but also -following orders of the Deputation- on large projects aiming at expanding the network. - Their juristiction covers especially the management and operation of the A-8 highway in the sections that cross their historical territories. So they embark not only on maintenance tasks but also -following orders of the Deputation- on large projects aiming at expanding the network. - They embark not only on maintenance tasks but also -following orders of the Deputation- on large projects aiming at expanding the network.
Transition period:	

Continued on next page

Table 4.5 – continued from previous page

A-8 concession, Basque Country, Spain
- One of the first actions the Deputation of Gipuzkoa took was to apply soft tolls (peajes blandos) that meant a reduction of 50% of toll fees. - Finally the public tendering process was initiated by Bidegui -the recently created Public Concessionarie. - Bidelán (a special purpose company) was selected and started taking care of the maintenance of the A-8 in March 2003. Also in 2003 Bidegui embarked on a large project to expand the road section Pasaia-Irún from 2 to 3 lanes. - Also in 2003 Bidegui embarked on a large project to expand the road section Pasaia-Irún from 2 to 3 lanes. Evaluation of results of first concession: - The outcomes from this first concession are difficult to judge: - In general, government authorities were cautious to express their disappointment about the state of the road when it has handed back to the government. - Other stakeholders from the area believes that it was given back in very poor conditions and that Europistas -the old concessionaire- must have had really high profit levels the last years because they did not invest on it the last years. - Meanwhile others believe that they achieved their goal, that was to set up the road, and that what went wrong was the negotiation between the concessionaire representative and the government authority. They believe the concessionaire did not invest the last years, waiting to know if they were going to be granted an extension. - The facts in the official handing-back report do acknowledge a very poor condition of the road. Characteristics of this public concessionare - Bidegui: - Financed by own revenues, direct tolls collected by Bidelán. 25% is given to the subcontractor -Bidelán- and Bidegui keeps the rest. Bidegui reinvests great part of these revenues in updating and expanding the network. - Small organization, less than 20 people who were all hired from outside the deputation. This has advantages and disadvantages. People in the Deputation thinks they lack some experience, but this also means there is less resistance to change -specially concerning granting design freedom or design tasks to private companies- in this new organization. - This kind of public companies have been created in other provinces as well, but not in the area of roads. The main idea behind them is to make the administration of roads quicker and to add more flexibility to the system, since they in principle are not obliged to the same requirements than standard government agencies. Nevertheless, in reaction to this freedom the EU has declared that they must comply with the same laws (contracting specially) than government agencies. - Another important reason to create a public company that would administer the income from tolls was to ensure financing for the transportation network - a problem worldwide.

4.2.3 Dutch procurement model

It is important to clarify that this overview of the Dutch situation presented in Table 4.6 is to some extent more recent than the one presented for Spain and Finland. The first overall comparison though has been realized for the same point in time (2006).

The main reason for revisiting the case is that it was not yet possible in 2006 -where they were still implementing their very first procurement strategy- to obtain a clear picture of the level of advance and the direction road authorities were taking. This is a valid choice -with not significant consequences for the validity of our research- since the aim of our research is to understand the whole evolution or reform path of the different countries and discover trends, not only compare how advanced one country is versus another.

The reform and implementation process in the Netherlands is different from the one implemented in Spain or Finland. This different way of reforming is highly influenced not only by the so called "polder model" of decision making but also by the technical or engineering orientation or culture of RWS itself. An example is to be found in the first procurement strategy (2004-2008). On the one hand this was characterized by an open set of intentions, with no fixed implementation or operation goals. On the other hand, a lot of effort has been invested on standardizing procedures that only recently -during the implementation of the second procurement strategy (2008-2012) are starting to be implemented. Evidence of the lack of clearness in the directions up to 2006 is shown in the following excerpt of the review of the Dutch Procurement strategy and practices prepared by Ray Simpson, the British expert on contracting. The Partner Program for Infrastructure Management (PIM) commissioned this review in 2006; two years after the implementation of the first RWS procurement strategy.

> Simpson observes that in the Netherlands common directives have not yet been formulated. This is a difference with England. Simpson uses as references his experience with the procurement strategy of the Highways Agency with whom he works already more than then years (excerpt from PIM project, resultaat 32: Review inkoopstrategie[1]).

In 2008, where the last interviews were realized, though it appeared not yet possible to cite a precise number of projects being realized in one or another way; it has been possible to confirm which is in practice the default option of project delivery method for new projects on each of the three road markets. This overview also reflects the vision set forward through the new procurement strategy (2008-2012). It could be said that in the Netherlands, what has been implemented is rather a set of decision rules, than a concrete operational plan. The description of the three road markets and their characteristics will offer concrete examples of this.

[1] Available at: http://www.projectpim.nl/onderwerpen/experimenteren/programmateam/resultaten/review_inkoopstrategie/

Table 4.6: *Overview of Dutch procurement model (2008)*

	Capital investments	Periodic maintenance	Routine maintenance
ALTERNATIVE FINANCING	3 PPP (DBFM) Projects (N 31, A59 & 2de Coentunnel) Plans to have at least 5 more (A4, A15, A2, Ring Utrecht, A27) Support of Minister of Finance (availability-based payments, no shadow toll)	100 % GOVERNMENT	100 % GOVERNMENT
INTEGRATION	100 % PROJECTS DB (no more new projects are being done under DBB scheme) Plans: 1) Since November 2008: DBFM unless (PPC applied to all projects above euro 112,5 millions)	E&C contracts (area-wise integration) KOSMOS - one time program to deal with backlog in maintenance	Service contracts contains all activities except winter maintenance,graffiti removal and incident management (contract unit/areas still under development) Traffic systems (and other technical installations) contracted out separately as "system contracts" Zeeland pilot: ROUTINE + PERIODIC (optional)
PERFORMANCE MONITORING	All contracts are now being described in terms of "functional requirements"		
	Uniform administrative provisions of integrated contracts (UAV-gc2005)		
	DBFM: Availability based payment - and usually penalty for inconveniences caused to traffic	- Suitability requirements for particular mix of bitumens	Performance is mainly: - Road availability: Closing of roads (lane rental) for realization of works - Time for reparation (reaction time) For technical installations: - Functionality - Reparation activities - Response (reaction time)
CONTRACT TERM	Last PPP (30 years) Normally 25 to 30 years	Standard 7 year guarantee for asphalt (now only 10-30% of the cases of reconstruction)	First 3+2, now 5+2 years
CONTRACTOR SELECTION	Goal: all contracts are awarded on the basis of the Most Economically Advantageous Tender Approach (EMVI criteria) Indicator: number of contracts awarded where price counted for a maximum of 50% in the final consideration (afweging)		
	Price/ Quality: 40 -60% but applied differently in practice Technical systems (new projects): 40-60% Quality	Price/ Quality: 40 -60% but applied differently in practice	Quality: 40 to 60% versus price However so far only one project where quality counted for 50% Technical systems: 30% Quality

Table 4.7: *Description of the N31 and the A59 projects*

N31 and A59
N31 • The 10th of December of 2003 RWS closed a DBFM contract with the consortium Waldwei.com for the N31. The project -of a magnitude of 80 millions Euro- includes the duplication of the single-lane road between Hemriksein-Nijega, the design and construction one aqueduct and one bridge; and the operation and maintenance of the already existing two-lane road between Nijega-Drachten. The construction started in 2004 and the road was delivered around 4 months earlier (31 October 2007) than planned (February 2008). The contractor will remain responsible for the operation and maintenance for the next 15 years. He will be paid for "keeping an optimal availability" of the road. • The winning consortium consist of: Ballast Nedam Infra, Dura Vermeer Group, HBG Civiel, Dragados (Spain), Imtech Projects, Oranjewoud and financing the project the Bank of Dutch Municipalities (Bank Nederlandse Gemeenten) and the NIB Capital Bank. The value for money calculated for this project through the Public Private Comparator (PPC) is of approximately 27%. A59 • This PPP project was commissioned by the province of Brabant in cooperation with the central government. The project include the transformation of the N50 - a provincial road between Rosmalen en Geffen- into the A59, including 15 years of maintenance. The companies that make part of "Poort van Den Bosch" are BAM, Boskalis and Fluor. The construction started in August 2003 and it was delivered the 10 of December of 2005. The contract is of a magnitude of 218 millions Euro. The contractor is paid per quarter based on the availability of the road. • The value for money calculated for this project through the Public Private Comparator (PPC) is of approximately 14%. Source: Ministerie van Financiën, PPS loket

Capital projects

(1) Private financing: In the Netherlands as in Finland, private financing takes the form of DBFM contracts with neither direct nor indirect toll, but rather lump sum payments based on availability. DBFM contracts are still relatively new in the road sector. Significant projects are the motorways A-59 in the South of the Netherlands, the N-31 in the North and the Second Coentunnel. Table 4.7 gives a short illustration of two of these projects. At least five more (road) projects are expected to be tendered using the DBFM scheme. These are: A4 Delft-Schiedman, A2 passage Maastricht, A15 Maasvlakte -Vaanplein, A2/A12/A27 Ring Utrecht and A27 Breda-Utrecht. The Second Coentunnel project will be

presented in more details in Section 4.3.1. PPP experts from the Ministry of Finance estimate that in the future 5 to 10% of the capital projects will make use of the DBFM project delivery method.

(2) Integration: in the Netherlands DB has become the standard project delivery method, and though it was not possible to confirm the exact percentage of projects being actually realized under this scheme, it is quite probably that in 2008 already 100% of the projects are realized in this way; since already in 2007 contractors reported that only 10% of the projects being tendered made use of the traditional DBB scheme. A recent change in strategy is the preference given to DBFM contracts for capital projects, instead of considering only the integration of Design and Build. This means that also maintenance will be part of the contract. In the first procurement strategy the directive was instead that the "procurement of construction together with maintenance is to be refused, or not to be approved; procurement of maintenance should be done rather from the perspective of optimal quantities and not from the perspective of accidental construction projects" (RWS inkoopstrategy 2004-2008, p.15). The new policy of the Ministry states that for all projects with a budget larger than 112.5 millions euro, there has to be a thorough research of the possibility of implementing them as DBFM contracts. This policy becomes operational in the procurement process by carrying out a Public Private Comparator (PPC) study for all projects with an estimated budget above this limit[2].

(3) Performance Monitoring. A substantial advance towards the use of more performance-based indicators rather than effort-based ones is noticed in the Netherlands. This advance is seen in two recent changes. First, in the implementation of functional indicators instead of technical specifications, as nowadays all contracts in the three markets - capital investments, periodic maintenance and routine maintenance- are being specified in functional terms. Second, in the application of a new way of managing contracts and monitoring contractors, the so-called system-oriented contract management (SCB), especially in DB, DBFM and E&C contracts, but also applicable to long-term integrated maintenance contracts. This methodology is the way the Dutch have operationalized the so called "own responsibility principle" which has also become the standard is post-contract monitoring in Finland. This methodology has been applied to all new projects in the three sub-markets, the 2de Coentunnel (capital project), Kosmos (periodic maintenance) and the Zeeland integral maintenance contract (largest component is routine maintenance). More details about this methodology are shown in Appendix E. In all contracts, especially DBFM and all other contracts where contractors are in charge of daily maintenance of the road, the most important performance indicator is the availability of the road. Therefore

[2]The PPC is an instrument to assess, quite in advance before the tendering of a project, the possible added value of an innovative contracting arrangement in comparison with the traditional approach.

special attention is paid to two aspects, lane rental (which is based on the number of times the road is closed due to maintenance activities and the duration of these closings), and response time (the time it takes to a contractor to repair certain urgent deviations in the road, also those consequences of a recent traffic accident). There are heavy sanctions associated with closing a road section; a sanction could be of up to 15,000 euro per hour per lane being closed during the day.

(4) Contractor selection. The general ambition of RWS is that all construction and maintenance contracts are awarded on the basis of the Most Economically Advantageous Tender Approach (MEAT[3]) where quality counts for 40 up to 60% of total points. However, as relative large discretion power has been granted to the local authorities tendering -so that they can decide per project which is the optimal weight for quality criteria- the way this approach is applied in practice is still far from the goal set. According to Bouwend Nederland -the organization that officially represents the contractors in the branch- still in 2008, 85% of the cases contracts were awarded on the basis of lowest price[4]. The situation may be different in different market niches. According to an interview with Imtech -a company specialized in providing technical services- the situation for technical installations and traffic systems is somewhat more advanced; already since 2006 contracts for installation of new systems are awarded using a weight of 40 to 60% for quality, and maintenance contracts for these systems using a weight of 30% quality.

(5) Main general procedures. As it was mentioned previously, in recent years there are three instruments or procedures that have been developed and implemented in the standard tendering procedures for all three road markets. This gives a first indication of a particular characteristic of the Dutch procurement model and the way of working of RWS. Priority is given to the development of instruments, before any new practices are implemented. See the following excerpt, translated from Dutch, from a report of RWS on their new procurement strategy:

> Development of instruments. Since the business plan 2004-2008 RWS works with performance-, D&C- en PPP contracts. In the beginnings in 2004 the number of instruments (standard contracts and procedures) and the knowledge about these instruments was limited. Many instruments and procedures are by now developed and in more or less degree implemented and have become widely accepted. In 2008 and 2009 these instruments will be further developed and adapted to facilitate a more simple and easy application (Rijkswaterstaat 2008).

[3] EMVI criteria in Dutch, refer to Appendix E

[4] Bouwend Nederland base this information on a constant monitoring effort they realize of the invitations to tender published for the sector of roads. It seems that most clients will start by assigning a weight of around only 20% to quality, instead of the 40% advised by the EMVI approach.

These three instruments are the specification of requirements in functional terms, the Most Economically Advantageous Tender Approach (EMVI) way of awarding contracts and the System Based contract management methodology (SCB). Two of these are explained in greater detail in Appendix E.

Routine maintenance

All routine maintenance activities in the Netherlands are nowadays outsourced making use of integrated performance-based contracts. The main difference of these contracts versus the ones used in Finland seems to be that:

- Winter maintenance, a main component in Finnish contracts, as well as graffiti removal are not included.
- Traffic systems and technical installations are also contracted in separate contracts called "system contracts".
- The contract unit or areas covered are still under development and this process of defining them has been ad-hoc and not planned and decided in advance as in Finland.

Further, these contracts differ greatly from the Spanish service agreements in the following aspects:

- Incident management does not fall under the responsibility of contractors.
- Payments are lump-sum.

Service agreements for traffic systems and technical installations cover different areas than contracts for asphalt maintenance activities. The unit is normally the traffic system of a province, therefore their name "system contracts". Nevertheless both service agreements have similar time duration and both are performance-based and lump sum contracts. Deductions from these monthly payments, and evaluation of contractors' performance in general, takes place based on the number of failures affecting the functionality of the system, the number of reparation activities realized and related response times (i.e. the time it takes the contractor to repair these failures). As mentioned before, though the goal is that quality criteria count for a minimum of 40% in the awarding decision, so far the weight being applied is of about 30%. The main quality criterion considered is the proposed way of working of the contractor, which includes between others the levels of functionality and response times he guarantees.

In November 2007 around 50 of these performance-based contracts were already under implementation. Future developments expected in this market are that almost all tenders will be awarded on the basis of the EMVI approach, contracts will integrate civil works, with electrical and mechanical installations and calamities and all contracts will be managed following the so called System-oriented contract management or Systeemgerichte contractbeheersing (SCB).

Table 4.8: *Dutch performance-based contracts for maintenance*

Performance-based contracts
(In Dutch: Prestatie bestekken) Performance-based contracts for maintenance of roads and of technical installations are characterized by: • Duration of service agreement: three years plus an additional term of two years in case of good performance. Recently some contracts offer five years plus two. • A certain performance or level or service is required from the contractor for the whole contract period instead of specific frequencies. • E.g. a contractor is required to keep the grass under a certain maximum length and not told how often he should cut it. Accordingly the contractor is not paid depending on quantities but a fixed lump sum or service fee per month. • Risks are distributed as follows; the contractor runs with all risks related to weather circumstances, while the road agency takes care of cleaning out of graffiti. In service agreements for technical installations the road agency also takes care of the replacement costs (of system components) above a certain amount established in the contract. • Weight of quality selection criteria should be between 40 and 60%. Quality-related criteria are: inconveniences caused to traffic, minimum time for reparation or minimum time of disruptions, maintenance strategy proposed, ability to forecast periods of non-availability and proposals of how to improve quality.

A pilot project that already implements few of these developments is the Zeeland network contract. This contract is one of the first from Rijkswaterstaat providing for the integration of both maintenance and management of pavements. In this case 14 small contracts covering all different types of maintenance tasks have been tendered out as one single integrated contract to Heijmans, one of the five largest Dutch contractors. This contractor will take care of management activities such as road inspections, trunk road maintenance and renovating a number of service areas. See Table 4.9.

Periodic maintenance

As the three general procedures introduced before -EMVI, SCB and functional specification of contracts- also apply to this segment of the market, this is the area in which the Netherlands shows a relatively further advance towards granting more design freedom to contractors, than the other two countries. Engineering and Construct (E&C) contracts have since 2007 become the standard for the delivery of periodic maintenance activities.

The relative advance is seen precisely in two elements. First, functional requirements, so that contracts are less prescriptive and contractors have somewhat more freedom in the design of the mix of bitumen; and second, the system-oriented (SCB)

Table 4.9: *Network-oriented Procurement pilot of Zeeland trunk roads network*

Pilot Project - Management and maintenance of Zeeland Highways Network Beheer en Onderhoud RWS Zeeland Areaal in Dutch)	
Project location:	RWS Zeeland (Province)
Contract Value:	Approximately €11 million
Beginning of contract:	1st May 2007
Activities of the project:	To manage and maintain all trunk roads in the province which includes: - Asset management: all routine maintenance activities (i.e. crash barriers, marking, road equipment, service areas, public lighting, traffic regulation equipment, tunnels and greenery and removal of graffiti) and management of the infrastructure - Renovation of seven service areas (DB contracts) - Monitoring and inspection activities. Contractor assumes the additional role of traffic inspector. - Providing all the following services: fault responses, management of incidents, introducing and keeping up to date the Maintenance Management System (OMS), consisting of different geographic information systems and administrative processing of damage. - Optional periodic maintenance: Contractor can and is expected to submit improvement proposals , especially for light periodic maintenance actions. If RWS approves such additional periodic maintenance works, the contractor will be paid a fee for his advice (consultancy service) plus the costs for carrying out the maintenance action proposed.
Contract area includes:	174 km of trunk roads, 16.2 km2 of vegetation, 69 viaducts, 17 bridges, 1 flat tunnel, 58 culverts, 27 traffic-regulation facilities and 5.3 km of sound barriers.
Contract term:	5 years with the option of a 3 years extension
Payment:	periodic lump sum
Functional specifications:	Desired quality defined in terms of service levels (E.g. contractor is within one hour -after an incident is reported- in place and with all the necessary materials to reinstall traffic, asphalt complies with a given friction coefficient).
Monitoring:	implementation of the so-called System-oriented Contract Management Approach (SCB)
Contractor selection:	60% quality and 40% price. Tendering procedure emphasized, besides price, on some quality criteria such as management of vegetation (30%), minimum traffic disruption (20%), maintenance plan (10%) and proposals for improvement (5%). In total 12 quality criteria were taken into account.

way of monitoring contractors' work. This relative advance towards more innovative methods is also seen in the fact that low bid is not anymore the standard awarding method (at least not officially), and new contracts aim at integrating more road sections and or bridges and aqueducts than traditional ones.

Nevertheless in absolute and practical terms, freedom remains limited and the sector rather traditional. Contract duration ends with project delivery and a contract includes only a single phase of the life cycle. An exception is KOSMOS, a one time program implemented in the Netherlands to deal with the backlog in maintenance (see Table 4.10). As in Finland and Spain, the Netherlands is considering reforming this sector by integrating routine and periodic maintenance activities into single long-term contracts.

Table 4.10: *KOSMOS, Dutch national periodic maintenance program*

Periodic maintenance program-KOSMOS	
Program location:	National highways network
Contract value:	The total value of the program is approximately €400 million. The value of each contract varies between €15 and €75 million.
Implementation date:	2006-2007
Program objective:	Handle maintenance backlog of national highways within the minimum time -2 years- and causing the minimum amount of disruptions to traffic
Program organization:	10 clusters or regional contracts. A cluster covers between 60 and 160 engineering structures and includes inspection and examination contracts. A description of one of these clusters (i.e. the KOSMOS/A16, Ring Rotterdam) follows.
Cluster A16 includes:	Realization of substantial interventions (rehabilitation and/or renovation) of the highway A16, combined with periodic maintenance to 150 engineering structures in the Northern part of the Zuid-Holland province.
Contract term:	7 years guarantee
Payment:	lump sum
Functional specifications and freedom granted:	Contractor can define the problem and make changes in the scope of the project, therefore he becomes responsible for the whole contract and the collection of data.
Monitoring:	Implementation of the so-called System-oriented Contract Management Approach (SCB). In this contract there is an additional player, the TIS (Technical Inspection Service) which ensures an independent quality control of the work of the contractor.
Contractor selection:	60% quality and 40% price (EMVI approach). Three quality criteria were considered: minimum traffic disruption, total life cycle costs (LCC) and risk management program.

As mentioned before, Engineering and Construct (E&C) contracts have since 2007 become the standard for the delivery of periodic maintenance activities. Some of the main characteristics of these contracts follow:

(1) Level of integration: E&C contracts are discipline-oriented, which means that not many phases of the life cycle or different tasks are included. Nevertheless there is integration area wise. Contract sizes are decided along the organizational limits of road authority districts. The goal is to keep increasing their geographical scale; by integrating 15 to 20 traditional contracting units (i.e. one bridge) in a single E&C contract.

(2) Performance monitoring: in term of performance indicators; DB (called Design & Construct in the Netherlands) and E&C contracts are tendered according to "Uniform Administrative Provisions for integrated contracts" (UAV-gc2005). To be more precise, this means that there are certain specific requirements of "suitability" that a certain mix of bitumen's must satisfy. E&C contracts require of asphalt concrete pavements that they follow the RAW 2005 provisions (update of 2007) and that the mix of bitumen complies with the sharpened functional requirements for heavy traffic roads. These functional characteristics are defined in terms of water sensitivity, minimum and maximum stiffness, resistance to deformation, tire wear and the like; for the different components: binding, bound and unbound layers.

(3) Contract term: the formal relationship ends immediately after project is delivered. However contractors do offer a guarantee for the next five to ten years. These guarantees vary per subcomponent. Thus, not all elements of the rehabilitated facility are equally guaranteed. For asphalts the standard guarantee is now seven years, but experts judge that problems will actually show up around the eighth year.

(4) Contractor selection. Though the goal is to implement the EMVI approach and that quality counts for a minimum of 40%; in practice the approach is applied by giving quality a weight of just 20%. Accordingly in most of the cases price remains being the dominant criterion.

Main characteristics of the Dutch model

The Netherlands overall procurement strategy can be characterized by:

- Very integrated especially life-cycle-wise in what refers to capital investments. DB has become the standard project delivery method and recently for larger projects the possible advantages of using DBFM must also to be taken into account. Quite traditional in periodic maintenance, but somewhat more advanced than in the other two countries as E&C has become the standard delivery method.
- Concerning selection criteria, the goal to assign a weight of 40 to 60% to quality seems rather ambitious. Nevertheless as the specific quality criteria to be con-

sidered and their total weight is decided per project, in practice price remains being the dominant criterion.

- Not so much advance towards real outcome or performance indicators. Instead a combination of the so-called own responsibility principle (Quality Control System proposed by contractors themselves) -which is more process oriented- and checking of rather physical outputs -through spot checking of road friction coefficients for example.

- All in all the priorities seem to be to advance further towards performance-based contracts, DB and DBFM project delivery methods.

Nevertheless, it should be notified that, an accurate evaluation of the relative advance in each of the aspects has proven more challenging for the Dutch case than for the other two cases. Innovative procurement practices have been implemented with little uniformity. This problem is clearly expressed by the representative of the contractors in the concrete sector in an interview for Bouwend Nederland (December 2007):

> RWS is a large organization with different departments and divisions each of them working in a different way. The consequence is that the principle "the market unless" is everywhere worked out in the contracts in a totally own and different way. The question remains how the contractor should interpret this (Kruizenga 2007).

This lack of uniformity is probably the result of a combination of external factors as well as elements proper of the Dutch policy making and the organizational culture of RWS, some of these follow:

- The reform and the advance towards the use of innovative contracting practices have been characterized by a relatively low speed of implementation and a missing sense of urgency, in a political and financial sense. The known Dutch polder model of decision making that makes somewhat more problematic the application of a top-down approach; worsened by the large size of the organization.

- RWS as a former purely technical engineering institution is characterized by a very cautious approach that relies heavily on procedures. Their typical approach is to start by preparing methods and procedures and carrying out pilot projects, before directly implementing new practices. And Even if the general ambition is to implement some of these innovative practices in full scale, the two procurement strategies formulated so far limit themselves to suggest the use a series of decision rules and instruments. Large freedom is left to the different divisions to apply them at their discretion on a project basis.

- The fact that RWS has historically been in charge of water management and protection of the Dutch territory against floods seem to play a role for the relative large authority they enjoy.

Even though these differences, there is a key aspect in which Finland and the Netherlands seem to be quite similar. Their main philosophy has been to implement practices that are as little demanding for the personnel of the agency as possible, so that a reduction of the government personnel is possible.

4.3 Most innovative projects per country

As explained in Chapter 2, the empirical comparative study has been designed as a case study research with embedded units. This section will present a summary of the findings from the study of particularly innovative PPP projects recently implemented in Finland, Spain and the Netherlands. These findings will be presented according to the research questions posed for this embedded unit of the study and in a comparative fashion. The study of these particular projects is expected to facilitate the understanding, in a more operational level, of national particularities in contract management practices as well as of the real degree of design freedom been granted, between other aspects.

It is important to recall that the different questions answered per project match the typology of contracts proposed by Ménard (2002) from NIE - in terms of duration, degree of completeness, incentives and enforcement mechanisms- but somewhat adapted to the specific case of road contracting. The adaptation to road contracting is based on the list of issues found in practitioners' literature on procurement and performance contracting.

The projects researched per country are: in Finland, the E-18 DBFM contract; in the Netherlands, the Second Coentunnel -DBFM Project; and in Spain the A-2 shadow toll concession for upgrading and maintenance.

4.3.1 Project description

The following three subsections -project description, procurement model and contract requirements- give answer to the first research question; what is in the contract? These three elements correspond to what NIE would call a description of the transaction involved.

Finland: E-18 project

The project involves the construction and operation of a 50 km section of the E18 motorway between Muurla and Lohja, including seven tunnels, eight interchanges and forty-nine bridge sites, under a DBFM. The capital cost of the contract is estimated to be approximately EUR 360 million; but including the service agreement the contract value amount to EUR 700 million, making it the largest PPP project to be implemented in Finland. The new motorway section will complete the missing link between Turku

and Helsinki, an important link for international transit traffic. The contract was signed in October 2005.

The Netherlands: Second Coentunnel

The project involves the Construction of the second Coentunnel (and revamping of the first Coentunnel) and reconstruction of the surrounding infrastructure under the terms of a DBFO concession, under which 10 km of the A8 and the A10. The tunnel is located in the Northern conurbation of the country (Noordelijk Randstad) and therefore is a cornerstone of a series of infrastructure capacity enlargements aimed at improving the access to this main road network. The current Coentunnel is the most important bottleneck in the link between the areas in the north and the south of the North Sea Canal. The total approximate value of the project (total life cycle costs) is 1.2 billions euro. The contract was signed in April 2008.

Spain: A-2 Shadow toll concession

The project Calatayud-Alfarajín (A-2) is part of the program of upgrading of the first generation highways (in Spanish Plan de Acondicionamiento de Autovías de Primera Generación). This program comprehends the upgrading of 2,231 km of roads, for which an investment of around EUR 6,334 millions is estimated and an implementation period till 2011. Concessions will be granted for 19 years. The goal of the program is to adapt these roads to the quality and safety standards required from the modern highways. The first generation highways were built halfway the 80s as part of the General Plan of Roads (Plan General de Carreteras).

The program consists of two phases. The first phase includes the tendering of six sections or contracts and concerns the conditioning of the most urgent and important links (A-1, A-2, A-3, A-31 and A-4) for which the preliminary designs and studies have already been realized. The second phase will cover the conditioning of the highways A-5, A-6 and the section "Igualada-Martorell" of the A-2. A total of 16 contracts will be tendered between 2007 and 2009. This program certainly reflects one of the characteristics of the Spanish way of implementing new contracting practices. Often when a new type of concession is set in the market, a number of projects utilizing this scheme are tendered or at least announced at once, creating enough deal flow for the private companies.

The project Calatayud-Alfarajín (A-2) involves a concession of 19 years under shadow toll for with no cost for users; that comprehend the upgrading, maintenance and operation of the section Calatayud-Alfarajín, -in total 107.2 km- of the Province of Zaragoza. This highway section is characterized by high traffic intensity, from touristic activity as well as heavy traffic, mostly in the final section near Zaragoza. This road section is located on the main A-2 corridor.

The first estimated budget for this project was of EUR 822 millions. Nevertheless the project was opened for tendering for EUR 653 millions and it was finally awarded

to the consortia Ferrovial- Grupisa for only EUR 403 million, in June 2008. The investments required for the next 19 years are expected to reach a total of around 331 millions.

4.3.2 Procurement model

Finland: E-18 project

The E-18 project is being contracted using a life-cycle model characterized by:

- Contract period of 25 years.
- Service requirements are described in terms of performance specifications (e.g. top surface of the road, environmental factors, fittings and equipment) and technical product requirements (for long-term structures).
- The payment mechanism combines the quality and quantity of services produced with the service fee. In other words, the availability of service defines the basic amount, while the monitored criteria create variability.

The Netherlands: Second Coentunnel

The procurement model of the Second Coentunnel shows many common characteristics with the Finnish E-18. Contract duration is somewhat longer, 30 years after project delivery, planned for 2012.; but payments are also availability based. What characterizes this project is the tendering and awarding procedure implemented. The contract has been awarded under the competitive dialogue procedure. Some of the characteristics of the process followed are:

- First five candidates were selected to take part on the tendering. All the different consortia were invited to present a plan of approach. The competitive dialogue was primarily aimed at the so called "critical success factors" for the construction. The most important success factors were; the management plan for the next 30 years, the stability of the first Coentunnel during the construction of the second, the dynamic traffic management method, the availability of the lanes and the degree to which it is ensured that the flow of traffic at a normal speed remains undisturbed.
- On the basis of these plans, and supported by a board of experts for each of the critical success factors, there were three parties selected.
- In the next phase -of consultation and dialogue- the agency discussed with the selected consortia to which degree their specific ideas fit within the frameworks put forward.

- In the last phase takes place the definitive tendering takes place and the contract is awarded to a single consortium.

- The final awarding decision was made making use of the MEAT (EMVI) approach, where both, price and quality were determinant. Very important quality criteria where which risks -of the total list of risks provided- the contractor proposed to take and which wishes he offered to fulfil.

- If he does not take a particular risk, the price of this risk is added to the price offered, while if he proposed to do something above the minimum requirements and within the price ceiling set, then this win for him a discount.

Spain: A-2 Shadow toll concession

The project has been procured as a Public Private Partnership to upgrade, finance and operate the established road section, under a shadow-toll concession. As the upgrade of this road section requires total redesign of the existing road to comply with modern quality and safety requirements the model is in fact not so different from a DBFO or DBFM model. Main innovative features of the procurement model applied are:

- This is the first project in Spain where the concession model is applied for the upgrading and maintenance of an already existing road; and the first project where both periodic and routine maintenance are contracted from a single contractor for a very long term.

- Different than in previous shadow toll projects in Spain; payments are not only based on traffic volumes -making use of an agreed tariff per vehicle per km- but conditional on the fulfilment of a set of performance standards. This new payment mechanism adds a new type of risks to be assumed by contractors, the availability or performance risk; added to the demand risk they already used to bear under traditional concessions.

The contract has been awarded with a weight of 50% for price and 50% for quality (technical aspects). Main economic or price criteria were the tariff per vehicle per km offered by the contractor (45 points), the maximum traffic limit offered per kind of vehicle (25 points) and the economic-financial plan of the contractor (25 points). The total number of points for the economic offer is 100. Quality criteria are divided in technical quality of the offer (88 points) and management plans per area (12 points). It is important to mention that the number of offers presented was significantly high, 18 different consortia; while the average for direct toll concession projects is 6 or 7 bids.

4.3.3 Contract requirements

Finland: E-18 project

Essential contract requirements are divided in; performance (output) specifications, technical requirements, method requirements and hand-back requirements. Performance (output) specifications stipulate the required quality during the maintenance period, but not necessarily the service life of long-term structures. These specifications also include the definition of deductions according to specifications.

Technical requirements are still necessary because performance specifications do not cover all structures. These requirements are especially used in connection with long-term (50 to 100 years) structures. They complement right-of-way plans and are decisive for evaluation of general quality requirements and work instructions. Technical requirements are considered first in order of validity. Meanwhile method requirements deal with work or quality insurance methods. They complement performance and technical requirements so that service life requirements can reliably be ensured, especially for long-term structures.

Finally, hand-back requirements define the required delivery condition or remaining service life (and residual value) of the contracted facility. They complement performance specifications. The complete list of requirements for the E-18 project can be found in Appendix F.

The Netherlands: Second Coentunnel

Similar types of contract requirements -from the E-18- have been formulated by RWS for this project. Nevertheless, there are two aspects that differentiate the formulation and enforcement of requirements of this project vis-à-vis recent road infrastructure projects:

- Functional requirements were formulated making use of systems engineering techniques[5] and with emphasis on the management of risks.

- Monitoring takes place by making use of the System-oriented Contract (SCB) management approach.

[5] In systems and software engineering, requirements analysis encompasses those tasks that go into determining the requirements of a new or altered system, taking account of the possibly conflicting requirements of the various stakeholders, such as users. Requirements analysis is critical to the success of a project. Systems engineering techniques are used in complex projects: from spacecrafts to chip design, from robotics to creating large software products to building bridges. Systems engineering uses a host of tools that include modelling and simulation, requirements analysis, and scheduling to manage complexity. Requirements must be measurable, testable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design. Source: Nation Master Encyclopedia, available at `http://www.nationmaster.com/encyclopedia/Requirements-analysis`

Spain: A-2 Shadow toll concession

Again, similar types of requirements as in the two previous projects apply in this case. Nevertheless it should be emphasized that the concept of performance indicators as central contract element, is new within the Spanish context. These new concessions are the first ones that make the realization of payments conditional on the fulfilment of strict quality requirements. Contractor performance will be periodically evaluated according to 41 indicators that regulate the condition of the road as well as the quality of the service delivered by the concessionaire. The complete list of indicators is presented in Appendix F. An analysis of the most important ones is presented in the following section.

4.3.4 Design freedom and innovation

It has been confirmed that design freedom granted to contractors remains limited, even in these three innovative projects. According to contractors and authorities there are a series of common regulatory and formal obstacles that reduce the design space that could be granted. Main obstacles are the so-called Right of Way procedure and the Environmental Impact report; both have to be obtained by the government before the project can be tendered. They limit design freedom in a spatial sense, since the complete route of the road section is decided.

Obstacles are also found within informal institutions; and it is precisely here where main differences between national styles are found. Finnish and Dutch contractors hold responsible their road authorities and the conservative attitude of public servants; but they also recognize the claim of authorities that there is in general lack of experience in the (private) sector in what concerns the use of functional requirements and specification. There appears to be a problem of attitude also within the private sector. Authorities observe strong risk aversion on the part of contractors, especially during construction phase.

> They would not implement any new technologies for the construction unless the agency would explicitly require it and be open to share with them the financial risk. (Interview with member of management team Second Coentunnel, 15 September 2008).

Meanwhile in Spain, though equivalent formal limitations apply as in the Dutch and the Finnish case; in practice more freedom seem to be granted thanks to the attitude of parts, the Ministry and the contractor. This project is not an exception; this different attitude toward changes proposed by the contractor, is in fact a characteristic of the Spanish institutional context recorded in many other examples during field research.

To be more precise, this means that although a first design (anteproyecto) has been prepared by the Ministry before tendering, the winning contractor could still propose certain variations and implement them if these are deemed as "logic" or making sense by the Ministry. This is also the case in traditional capital projects where contractors

receive a very detailed design or "proyecto constructivo" that though in theory would represent a design of 100% and no freedom at all, in reality it may still leave them a 10% of freedom. See the following excerpts from an interview with an engineering consultant (May 2007):

> I would definitely say that the "proyecto constructivo" does not define the 100% of the design; because there are always changes. The reality is that this design undergoes always changes, there is no project that is done exactly as first established. ... I believe that the Spanish contractor does not conceive a project without modifications. (Engineering consultant participating in the preparation of the contract terms for this project)

This different attitude -from both parts- was also confirmed by a representative of one of the largest concessionaire companies (Dragados) (May 2007). He believes Spanish road authorities are more flexible and experiences or effective in implementing long-term contracts and public private partnerships than their Northern colleagues. Northern road authorities aim at very complete contracts that cover and fix each and every detail of the project and the relationship, while Spanish authorities were more aware that under such long-term schemes renegotiations would be needed.

Even though the many limitations and obstacles in place, it was recognized by both contracting parties that these projects do grant more design freedom than traditional project delivery methods do. Examples of such additional freedom for each of the projects follow. In the E-18 project, bidders could introduce alternative solutions. Finnra gave contractors the results from soil surveys so that they could work alternative designs in their preliminary construction plans. Besides, the Right of Way granted for this projected allowed a 2 meters range of variation.

Greater design freedom was achieved in the Second Coentunel by awarding the project under the competitive dialogue procedure. Accordingly, contractors were asked to present innovative alternatives to handle the so-called main success factors of the project. Market players were explicitly challenged to use their expertise and creativity. The consultation and dialogue phase of this procedure allowed for a freer and open exchange of ideas between RWS and the different participating consortia.

The A-2 concession did represent a relative advance in design freedom since contractors received a first design or "anteproyecto" that defines the project in only approximately 70%. On the basis of this first design, they had the freedom to prepare more specific construction plans or "proyectos constructivos" that define the project to 90 or 100%. They had almost total freedom to choose materials and particular technologies. In most projects changes to these aspects require a final approval from the Ministry, but in this case since the contractor is going to be judged more in terms of performance he has been granted more freedom. Contractors can in fact change or propose alternatives for the different structures and foundations, of course respecting the right of way and the relevant technical standards (normativas).

Positive results of this relative increase in design freedom along with a new way of working between engineering consultants and contractors (due to the integration of design and construction activities) have been recorded. In both, the E-18 and the Second Coentunnel, a new kind of innovation and savings in total Life Cycle Costs (LCC) are being achieved as contractors and consultants learn to work together with the common goals of minimizing total costs of ownership of the facility. Two examples are presented.

The first was provided by a Senior Consultant of the CE firm teaming-up in the winning consortium for the E-18 project in Finland (3 April 2006):

> Now we (consultants) try to work differently. Traditionally the designer worked alone and only once he had finished its task, could the construction contractor starts working on the project. Now we try to work together. In the new E-18 project we have an example of the innovation that it can be possible thanks to this cooperation. It concerns the lighting of the project. In this case we first calculated an overall figure (e.g. quantity of light posts); then the contractor selected a supplier; and subsequently we continued working on the final design of the system together with this supplier in order to find the optimal distance between light posts. The solution attained will generate important life cycle savings because the total costs of lighting the tunnels is equal to construction costs plus energy costs over many years!

The second was provided by a member of management team Second Coentunnel (15 September 2008):

> The winning consortium is discussing a new option for the lighting and the location of the lamps in the tunnel that will minimize the number of times the tunnel is closed during the 30 years period. Their idea is to install the frame of the lamps in the middle, instead of in the tunnels themselves; and from them bring the light to the tunnels using optic fibre. In this way maintenance of the lamps can take place without closing the tunnel.

No examples could be recorded for the A-2 Concession. When the interviews were realized the different consortia has just delivered their offers. It was therefore too early to evaluate the result of this procurement method in innovation.

4.3.5 Contract incentives

The different types of requirements applied per contract have already been presented. Here only the ones that are particularly influential or decisive to calculate the reward of contractors will be discussed.

What are the key performance indicators? What are the real decisive ones to calculate the reward of the contractor?

Since all contracts include a construction phase, followed by a long-term service agreement for maintenance and operation of the facility, contract incentives are two fold. In order to promote early project delivery, service fees start to be paid only after project delivery and official opening of the road. Some authorities also offer an extra bonus for early project delivery. Then, after project delivery a different set of incentives -linked to compliance with performance indicators- play a role.

Contractor's performance is continuously monitored and evaluated in terms of service levels; which have a direct relationship with routine maintenance activities. The evaluation of performance boils down to ensuring certain minimum values (specially related to friction or skid resistance) and responding to deviations and/or incidents within time. In a higher abstraction level, these two aspects ensure safety and the normal flow of traffic. Though all performance indicators are important and failure to ensure the standards required could lead to monetary deductions; the deficiencies that could lead the road authority to impose a severe penalty are the ones that bring in risk road safety. In Spain for example, from the 41 indicators 23 are considered to have a direct and immediate effect on safety. Besides, if one considers how often the values of these indicators are controlled -by contractor and road authority- the most important in terms of condition of the infrastructure are:

- Settlement and potholes of the road surface (number 9 and 10), which are supposed to be controlled daily and fall under the category of routine maintenance activities.
- Skid resistance (1), Macrotexture (2), IRI (3), structural strength (4) and cracks (7) of pavements, controlled annually and which reparation fall more under the category of periodic maintenance activities.

In all these three projects, monitoring takes place applying the so-called Own Responsibility Principle (i.e. reports realized by contractors about performance and about how they followed the quality control system they promised during tendering) plus random quality checks (i.e. spot checking) often realized by external consultants.

In the Finnish E-18 project an additional element is the bonus granted to the contractor, depending on user's satisfaction (user's line and survey) and controllers' evaluation.

Meanwhile, Spain seems to be ahead in the use of performance indicators and has gone further than the Netherlands or Finland to transfer to the contractor the responsibility for the management of incidents and safety. This is visible especially in indicators 18 to 20 (see Appendix F), two of which -danger index and mortality index- are clearly real outcomes. In the way they have been formulated (i.e. as the difference or relative change in the situation compared to the situation before the contractor was in charge) they represent a fair and good incentive for contractors to act speedily in case of accidents and be proactive to prevent them from happening.

Significant differences were recorded on the emphasis placed to certain indicators and accordingly on the monitoring and enforcement mechanisms applied by the different road authorities. These differences stem out from the payment mechanisms applied. While Finnra and RWS assume all traffic risks and pay the contractor periodic availability fees; the Spanish Ministerio de Fomento pays the concessionaire based on traffic levels, the equivalent shadow tolls. A detailed description of these two payment systems and how periodic fees determined is presented in Appendix G. Briefly, in the Second Coentunnel, payments are defined as follows. First a bonus or a sanction is given if the road is available or delivered earlier or later than promised. Afterwards for the next 30 years of the contract an availabity fee is paid on a quarterly basis. Meanwhile for the A-2 project, being a shadow toll concession, the indicator that fixes the base of the tariff to be paid per period, is first of all the number of light and heavy vehicles making use of the road sections included in the project. Besides this first indicator, the payment of contractors could be considerable affected by their performance in terms of the 41 performance indicators defined in the contract, which regulate the road condition and the quality of the service.

What performance indicators does the agency use - but are not used for rewarding?

Other sources of information not used directly for rewarding of contractors but to create general pictures of the performance of the overall system are:

- Number of accidents, fatal or not. Information is collected per region and may be part of discussions with contractors in charge of specific projects in the area.
- Monthly meetings with contractors and consultants to discuss the achieved performance.
- Hand-back requirements. They do not influence payments but are used as basis to follow up certain warranties. A couple of years before transfer is planned the principal will check the physical condition of the road sections, bridges and tunnels that make part of the project. If this is not as specified in the contract, contractors will have to realize extra works or strong sanctions will be applied.

These indicators and methods are common to all projects. As mentioned before, an important difference between Spain and the other two cases is that in the A-2 contract certain information about accidents and safety indexes do influence the rewarding of contractors.

4.3.6 Enforcement procedures

How is information provided along the project - on how the actual work construction or maintenance is done? How do they supervise or check contractors?

An interesting situation observed in the process of sharing of information was the constant tension or trade-off between (design) freedom given to contractor and risk

distribution or risk transfer. This tension is at the heart of the government duty of guaranteeing public values. Some examples from the E-18 project follow:

- During tendering: contractors can submit alternative solutions but they also have to send a standard offer where they give their costs for the main technical solution proposed, so that offers could be comparable. Offers need to be comparable to prove real competition, but this also means that contractors are still judged on the prices for the main solution, and not so much on how innovative their solutions are.

- During design: Finnra officials still want to check the drawings of the contractor, and they are allowed to do so, but they cannot directly ask changes to these, or will have otherwise to accept the responsibility or run the risk for that choice in the design. Nowadays however bridges still need full approval by Finnra experts, while at the same time contractors accept the risk, creating a grey area to be exploited in case of possible litigations.

Main flows of information during the contract term (E18) are:

- Meetings between engineering consultants and designers of the winning consortium and road authority design personnel.

- Authority project managers drive through project area and may ask questions to consortium personnel working on the project.

- Consultant in charge of checking the contractor realize random checks on the outputs of the project (spot checking) and on how consistent the contractor follow its own Quality Control system.

- Contractors prepare themselves a report about their performance and send it to the authority.

- Meetings take place between consultants (in charge of checking) and road authority personnel in charge of project.

- Meetings to discuss performance achieved and progress of construction phase with contractors, consultants and Finnra personnel.

Besides, given the private financing element of these projects, an extra actor exerts control on the contractor. The institution financing the project will also carefully check the risk matrixes of the project and the risk management plan of the consortium. This extra controlling agent is considered one of the main advantages of private financing; an agent who knows better than anybody about management of risks, checking constantly to ensure success for the project.

Differences between the three projects follow. Contractors in the Netherlands appear as less experienced in the use of the own responsibility principle. RWS have not yet

succeeded in applying the sanctions and procedures stipulated in the contract and in some cases ends up realizing direct supervision on the field. Meanwhile, few differences in the information flows for the A-2 concession are:

- The concessionaire receives direct feedback from users and it has also the duty to directly inform users themselves. All highways under concession regime in Spain offer an information line to users.

- If deemed necessary also subcontractors will be invited to take part on the periodic meetings to discuss performance.

In general - how does communication between road authority and contractor take place?

The communication between Finnra the winner contractor appear quite fluid and positive. It seems that the relationship agency-contractor in general is in Finland less distant than in the Netherlands; probably because there does not seem to be the case that too high risks are being put in the hand of contractors.

Up to this project stage the communication between RWS and the consortium appears to be relatively open. A positive result of this new procurement method has been the promotion of a more cooperative and less antagonist relationship between the contracting parts. The consortium seems aware that this contract entails a long-term relationship and therefore a different attitude is needed to implement it successfully. If a conflict between the parties would arise, the first step would be an internal discussion between RWS and the consortium. If they fail to find a solution both parties would appoint a group of experts. Both parties should recognize the members of this committee as neutral and with enough expertise in the subject. Only if this phase also fails, will the parties go to the judge.

Meanwhile in Spain, interviews on this project were realized to early to describe how the actual relationship between the authority and the winning consortium works. Nevertheless from other interviews it was observed that in Spain the contracting relationship does not limit to the strict administration of the contract clauses. It includes a varied array of information flows and even informal communications. It is expected therefore that communication between the parts will be fluid and the relationship is less distant and legalistic than in the Netherlands. There appears to be always room for renegotiation of contract terms.

Renegotiations are to be expected as this contract, and few others that make part of the upgrading plan, have been given to concession with falls of up to 49%, which brings seriously in risk the rate of return expected from this project. The four sections awarded in October 2007 were assessed by the Ministry to have a value of EUR 2,453 millions and they were granted to the competing companies for EUR 1,333 millions; 46% less than the amount requested. The Ministry had calculated a rate of return of around 9.5% for these projects, but this profitability has been diluted since the

competing offers have rounded the prices down far below the amounts for which the projects were been tendered.

> The only explanation for these extremes falls is that the competing companies have pushed prices down hoping to increase their portfolio and then wait to see what happens along the long life of the concession. (Source: Javier F. Magariño - Madrid - 24/10/2007, for the newspaper Cinco Días[6])

4.3.7 Dealing with opportunistic behaviour

What strategies did road authority have to combat the negative effects of information asymmetry?

Though some have been mentioned before, the following are common strategies that road authorities apply to combat the possible effects of information asymmetry:

- Combination of availability fee payments -subject to an availability correction and a performance correction - in combination with hand-back requirements.
- Spot checking, mainly focused on physical network condition aspects. In the Netherlands, the frequency and type of tests applied is defined by the System-oriented contract management method (SCB) approach.
- Large sanctions if contractor fail to follow own management plans and quality control methods.
- Meetings where performance achieved is discussed. This hopefully allows for more information and expertise being shared between both teams and therefore for reduction in information asymmetry. Face-to-face meetings may complicate the hiding or manipulation of information by the agent; vis-à-vis written reports prepared by a single person.
- Side effect of private financing: strict checking from banks on consortium risk management approach. Financiers share with road authority the interest on keeping project risks under control and ensuring a faster completion of the project.

What appears to be missing are strategies that combat information asymmetry related to costs; especially in the long term. Finnra and RWS for example, has got historical benchmarks of costs (applied through the so-called Public Sector Comparator) that allows them to evaluate ex-ante if an innovative project delivery -such as DBFM- will result in more value for money vis-à-vis traditional procurement.

[6] Available on line at: `http://www.cincodias.com/articulo/empresas/Fomento-adjudica-ultimas-autovias-bajas-49/20071024cdscdiemp_3/cdsemp/`

However they do not appear to have in place benchmarks with other sectors that may allow them a dynamic comparison of construction and maintenance costs in the future. Considering that these are contracts of 20 years or more, the dynamics of costs and technologies for such a long period of time, introduce a troublesome element. Such dynamics and the uncertainty introduced by it, endanger the long-term effectiveness of current strategies.

Given the nature of the Spanish A-2 contract and the payment mechanism chosen, additional strategies need to be applied by the authority. In this concession contract the most important pieces of information determining payment are traffic (number of vehicles) and the performance records of the contractor. Given that contractors themselves are the ones gathering both kinds of information, some of the ways the agency aims to prevent opportunistic behaviour is by setting major penalties in case:

- The contractor falsifies information about traffic flow or measurements on the different indicators.
- The contractors assigns in practice less personnel or machinery than promised for the operation of the contract.
- The contractor does not fulfil the minimum requirements for the defined performance indicators that are directly related with road safety.

Such serious non-compliances are sanctioned with fines of 100,000 to 500,000 Euros.

To control misinformation in traffic information the agency not only has to approve the location and periodic re-location of the points for traffic counting, but it will also realize a monthly inspection of the traffic in the highway and can at any moment install the counting procedures estimated convenient -fixed or mobile- and use them to compare and validate the information delivered by the contractor.

In addition, interesting strategies to control possible opportunistic behaviour, discovered for this A-2 concession are:

- Tendering rules. For this concession contract where important transportation links are been transferred to the concessionaire and the consequences of non-compliance could be catastrophic, the Ministry has set as condition for participation to: (a) either be a well-known integrated concessionaire, or (b) to form a consortium with a certain composition in terms of actions. This composition is to remain fixed throughout the whole contracting period. The minimum participation of companies specialized in maintenance and operation is 25 percent (25%) and the same minimum participation is required from companies specialized in highway construction. All participating consortia had to present prove of their experience in the relevant areas. Besides, as in such contract the role of engineering consultants is crucial, the Ministry has also required that both types of consultants -the ones assisting in design and redaction of constructive projects and the ones assisting in control and supervision- have a minimum share of 2.5

percent (2.5%). A share in the participating consortia will probably ensure continuity in the work being delivered and real commitment, as consultants will also carry risks or pay the consequences for the choices made throughout the different life cycle phases of the infrastructure.

- Regulation of subcontracting. As in the case of consultants, the expertise and continuity of the personnel in charge of daily maintenance activity is vital for the success of the concession. Therefore the winning consortium is not allowed to subcontract any of the operations in the so called Area 3, which correspond to all the works and management procedures of routine maintenance (Page 102, Pliego de Clausulas Administratives Particulares, section 59 on Subcontracting).

Further, different clauses in the contract concerning the way that sanctions are fixed and implemented show a serious consideration of the agency about the consequences of sanctions for market conditions and their role in creating the right incentives.

(1) Clause e, section 62.1, page 111, fixes a ceiling for the maximum amount a sanction should reach:

> The maximum limit of sanctions to be imposed on the contractor cannot exceed the 10 percent (10%) of the total budget of works in Area 1 during the construction phase or, the 20 percent (20%) of the incomes obtained due to the operation of the highway during the previous year, during the operation and maintenance phase. In case that it would be necessary to go beyond these limits, the Administration will take the decision to resolve the concession contract.

(2) Section 62.3 about the graduation of sanctions, or on how to decide what a proportionate fine is:

> The imposition of sanctions by the Administration should keep an adequate proportion or relation between the gravity of the non-compliance and the sanction applied, considering especially the following criteria for its proper graduation or scaling: (i) the type of non-compliance; (ii) the economic importance of the operation of the road; (iii) the degree of negligence or the existence of intentionality in the non-compliance or failure; (iv) the nature of the damage caused due to it; (v) the economic relevance of the damages derived from the non-compliance; (vi) the benefit obtained by the concessionaire; (vii) the relapse or falling in again in previous non-compliances during the implementation of the contract.

This last clause also reveals a peculiarity of the Spanish way of dealing with contractors and with opportunistic behaviour; the agency has the discretion power or room to

penalize harder "pure" opportunistic behaviour and to differentiate this type of non-compliance from a simple or accidental one; and there is probably room for negotiation between agency and contractors once such a sanction is been decided. In many other parts of the contracts it is found this legal space for negotiations in the future as problems arise; without fixing already in advance the detailed amounts and exact punctuation mechanisms. After all a contracting relationship in Spain is more than the legal documents, is been continuously built during the contract term and is based on a quite subjective aspect, trust.

4.3.8 Reflection

Similar strategies to combat information asymmetry and to limit opportunistic behaviour have been discovered along these three projects. Nevertheless, important differences were found in the practical application of performance requirements and enforcement mechanisms, as written contracts appear to play a somewhat different role in Spain than in Finland and the Netherlands. It has been observed in the A-2 concession as well as in other projects, that there is considerable room for negotiations after the contract has been signed. For example if the initial conditions of the existing road being given in concession are different than as described in the contract, then the authority could accept that the contractor does not deliver the performance required for at least a period of time. Instead of closing such a compromise favourable for both parties, in Finland or the Netherlands, road authorities would probably do all the necessary works to set the highway up to the conditions cited in the contract, and then require and strictly enforce the level of service and hand-back requirements as stipulated in the contract.

4.4 Comparative advance

An overview of the relative advance of the three countries in the use of innovative contracting and their particular nuances by 2007 is presented in Table 4.11. As it could be expected since Finland implemented the reorganization earlier; they are relatively ahead of the Netherlands in the use -at least in larger scale- of these innovative practices. By the end of year 2006 Finnra (Finnish Road Administration) presented to the sector their third procurement strategy while Rijkswaterstaat was just implementing their first procurement strategy.

Finland and Spain are both in general terms quite advanced in the use of innovative contracting and in the implementation of their own reform agendas. As mentioned before, Finland is now implementing already its third procurement strategy after the reform of 2001, and Spain has refined its contracting law to support the further development of the concession model not only for use in green field capital projects but also for the rehabilitation and maintenance of existing roads.

Concerning the different aspects of the procurement strategy (e.g. contractor selection and integration) the following subsections present an overview.

4.4.1 Contractor selection

Price is no longer the only criterion; quality aspects are also taken on board. Finland has standardized -at least for all routine maintenance contracts- that 25% of the points are assigned to quality criteria. Nevertheless, quality has a decisive effect of only 3%. In Spain, the weight of price is of only 40%. In the Netherlands this percentage still varies a lot per project, the intention is to give higher weight to quality aspects but till this moment the implementation has remained limited; routine maintenance contracts for example are in their majority still granted to the contractor with the lowest bid.

4.4.2 Integrated contracts

The process differs per product. In capital projects Design-Build (DB) is widely used. While in Finland it already represents 60% of the projects, in the Netherlands the goal is to use it for all projects by 2008. Spain is an exception in this respect, the use of DB contracts. Mainly due to the disappointing results they had using the "German" model of Design-Build[7] in the 1980s and 1990s using Design-Build (DB), DB is not a preferred method for delivering capital projects. An explanation to these disappointing results may be that in this particular DB model, there were no incentives built in for the contractor to finish work within time and budget.

For routine maintenance integration has meant the implementation of service contracts that include almost all routine and winter maintenance tasks in one. In Finland nowadays 100% of the maintenance is contracted out in this way. Meanwhile in the Netherlands the agency still performs around 24% of these activities in-house, and is developing new contracts and heading more towards the idea of corridors instead of districts or areas. In Spain, more specifically in San Sebastián, the use of integrated maintenance contracts started already in 1998.

The advance in the use of integrated innovative contracts is measured throughout the Finnish and Dutch national agencies in different ways, but is clearly a priority in both countries. Meanwhile, the advance in the use of innovative contracting practices does not seem to be followed up in Spain, at least not as explicitly.

4.4.3 Use of performance indicators and quality monitoring

The research pointed out that there are still many issues to be resolved before implementing fully outcome oriented indicators; such as the lack of complete databases on the assets and their condition; historical information of total costs of ownership (TCO) of a facility and reliable measuring techniques. Nevertheless the introduction

[7] Also called "Llave en Mano" in Spanish.

Table 4.11: *The use of innovative contracting in Finland, the Netherlands and Spain (2007)*

PROCUREMENT STRATEGY	Finnish Case	Dutch Case	Spanish Case
GENERAL ADVANCE	Periodic Maintenance still very traditional		
	- Policy and standard contracts in practice	- Still developing (i.e. size of Maintenance Service areas, contract term)	- A new model of extra-budgetary infrastructure procurement since 1996.
	- 2nd or 3rd procurement strategy	- 1st procurement strategy (2004-2008)	- Legally established by contracting law of public administrations. Last changes in the law realized in 2003.
CONTRACTOR SELECTION	70 to 75 % Price	Varying per project, but in general lowest price determinant	40% price
	Periodic maintenance 100% Price		
INTEGRATION	- Capital: 60% DB	- Capital: 100% DB goal by 2008	- Capital: DBB projects, bad experience with DB
	- Maintenance: Service area contracts (all included)	- Maintenance: 24% done by RWS. Unity changing towards the idea of corridors. Implementation of first integrated performance based contracts in 2004	- Maintenance: integrated contracts since 1998
	- Indicator: Average value tendered	- Indicator:% of projects tendered in period using innovative delivery methods (ambiguous)	- Indicator: no direct follow up of the use of innovative contracting
PERFORMANCE INDICATORS AND QUALITY MONITORING	Not yet real OUTCOMES but side steps		
	Standard use of "Performance" contracts (capital and routine maintenance)		In direct concessions, contractors do run with all risks, including market risks
	- Own responsibility concept plus	- Own responsibility concept (starting)	- Own responsibility concept
	- Spot checking	- Spot checking (starting)	- Contractors are seldom checked or penalized, the use of performance and quality indicators as determinants of
	- Consultants are employed for testing, oversight and spot checking	- Consultants are employed for testing, oversight and spot checking	
	- Users' line		
	Meanwhile → Development of functional specifications		
ALTERNATIVE FINANCING	- No future projects planned	- Plans for more future projects (30 planned)	- Private financing through concession model, since 1965
	- 1st project (shadow toll) 2nd (availability)	- Broad support	- Since 2004 also shadow toll
		- All recent cases: availability-based payment	- Expanding the model to cover maintenance investments
NEXT STEPS	General problem: costly maintenance of isolated road section		
	- Pilot project concrete roads network	- Accelerated/ combined maintenance of many bridges and roads	- National wide implementation of maintenance related tolls
	- Integration PERIODIC + ROUTINE	- Integration PERIODIC + ROUTINE for significant parts of the network	- Integration PERIODIC + ROUTINE maintenance in a new concession model
	More design freedom in periodic maintenance		Controversy going on about the new shadow toll method
	Tolls not accepted - unless under congestion/pollution scheme		

of performance oriented indicators is on its way, and the use of functional specifications has already begun. In the meantime, road authorities have found a way to grant more design freedom, decision rights and responsibilities to the contractor, by implementing the so-called "own responsibility principle", complemented by (random) spot checking.

In comparative terms Finland is ahead in the use of this way of post-contract monitoring. The Netherlands has started by first investing more effort on developing a complete method of contract management and monitoring techniques based on Systems Engineering that will support the implementation of this principle (SCB). Spain is instead a relative latecomer in this development. Given Spain's long term tradition on concessions, national contractors are more used to deal with market or traffic-related risks than with this new performance related risk that depends on government authorities' perception.

4.4.4 Alternative financing

The main difference between procurement strategies is to be found in this aspect. Spain is clearly far ahead in the use of private financing mainly in the form of direct concessions since 1965 and since 2004 also of indirect concessions that make use of shadow toll schemes, in the last five years -since 2003- the same concession models have also started to be applied to existing roads. Further, it is observed a relative further advance in the use of PPP schemes in the Netherlands than in Finland.

4.4.5 Common directions

In spite of the differences between countries, it becomes clear from the comparison that the procurement of periodic maintenance remains very traditional. Price counts still for 100% of the selection decisions and contracts are prescriptive, more "work order" style and valid for a very short term. Consequently there are plans in all countries to make important reforms in this sector, either by combining periodic with routine maintenance in one contract or by developing long term rehabilitation contracts for a whole road network.

Future reform plans appear to be aligned in the same direction for all countries. Nevertheless, the operational choices about how to implement these new integrated maintenance contracts and how to proceed with private financing schemes are expected to be quite different for Southern European countries like Spain than to Northern European countries like Finland and the Netherlands. The introduction of toll roads seems still unacceptable for Finnish and Dutch citizens, unless these are introduced in cities meant as congestion or pollution related taxes, rather than additional taxes to finance investments in road infrastructure. Almost contrarily, the controversy going on in Spain -since the introduction of shadow toll schemes by the socialist government- is that this way of financing is less transparent and could cost unpredictable amounts of money to future generations.

4.5 Overview of effects

Table 4.12 presents the most important results from the implementation of innovative contracting practices. It also shows that even though all road authorities are concerned with the procurement of road infrastructure; the essence of the problem they face is different and therefore the outcomes of interest or key performance indicators that matter for them too.

The results presented in this table are nevertheless relative and temporal/dynamic in nature. A rigorous and definitive assessment of the impact of innovative contracting practices on the performance of national road sectors has turned out impossible. Firstly, given the lack of systematic historical data on physical network performance and financial performance (e.g. total cost of ownership of infrastructure assets) that would allow for comparison; and secondly, as already mentioned, given the different importance attached per country to different performance aspects.

For Finland the most important achievement could be considered the creation of a whole new market; which is competitive and has resulted in prices being cut by approximately 40%. For Spain instead their success has been on implementing a renewed concession model that brought forward the hoped expansion and modernization of the road network.

While in Finland the problem of (physical) road condition remains a top priority - partly due to the extreme weather conditions and the extension of the network- the problem in the Netherlands has taken in the last decades a different form, being traffic management the first priority.

There is an ongoing discussion about how costs savings are calculated, especially since most projects have not been delivered back to the government yet; therefore is not yet known what will the total life cycles cost be. Another question is whether these savings are the result of innovations and real increases on efficiency on the side of contractors, or simply a temporal phenomenon due to strong price driven competition.

It is important to mention the positive effect these innovative practices have had on expertise levels in both sides. While the expertise of road agencies has changed toward more project management and legal related skills; contractors have also experienced a process of increasing professionalization- that becomes evident in the need they have of skilled personnel in both technical and project and risk management aspects.

Table 4.12: *Results of innovative contracting in Finland, the Netherlands and Spain*

Results	Finland	The Netherlands	Spain
General	- Successful and clear reform	- Slow and less clear reform - Even though more uniformity is still needed, the reform has resulted in further standardization of agency contracting and tendering procedures.	- Expansion and modernization of the national road network
Market development	- Creation of a new and competitive maintenance market	- The latest DBFM capital projects have received an average of 5 offers	- The market of capital projects -especially concessions- seems very competitive - Toll projects receive enough number of offers, an average of 6 to 7 - Successful Spanish companies (National champions) that lead the market of concession in Latin America and Europe - National authorities have managed to create enough deal flow and therefore also to keep transaction costs lower than in other countries.
	- Problem: risk of cutthroat competition	- Problem: not enough deal flow is been created for contractors and some contractors are already suffering the consequences of bidding too low in order to win long-term contracts	- Problem: informal barriers for competition from other EU countries and for smaller projects barriers to non-local players.
	- In all countries there are concerns about the effect of innovative practices and large integrated contracts on market concentration		
Time savings	- First PPP project was delivered 1 year earlier than planned - DB projects vis-à-vis traditional DBB does speed up project delivery	- The last road PPP project (N31) have been delivered four months earlier than planned	- Concession projects have proved to deliver projects around 21 months earlier than traditional delivery methods
Cost savings	- Routine maintenance savings of 30 to 40% have been achieved due to outsourcings	- Savings of around 20 to 30% in routine maintenance in the beginning - PPP projects seem to deliver projects an average of 15% to 20% cheaper than traditional projects	- Data not recorded
Innovations	- Mostly process related innovations, or implementation of new working methods or a better choice of equipments by contractors. New technologies are borrowed from experience of companies in other countries, but no really developed for particular projects. Given that construction represents the most risky face of the project and lenders exert extra control of contractors, no one dares to implement really new technologies on large projects.		
Expertise and professionalization of the sector	- The sector is changing in all countries. Companies required personnel with 1 or 2 levels higher of education. Other professionals like lawyers, finance and risk experts, and contract managers are gaining market in the sector.		

Continued on next page

Table 4.12 – continued from previous page

Results	Finland	The Netherlands	Spain
Users' satisfaction	- Remains good	- Remains good - Nevertheless, due to gaps in the definition or requirements or formulation of contracts, quite low quality has been delivered by contractors in certain cases	- Remains good
Main challenge faced by road authority	- Road condition, partly due to extreme weather and great network extension - Users' cost: time and vehicle costs - Winter maintenance service level	- Traffic and management of congestion, therefore: - Heavy sanctions "availability based" -Maintenance of technical systems (light and traffic) that represent more than 60% of the total LCC of the road -Seldom extreme weather conditions: RWS keeps the power to call on contractors for winter type maintenance	- Updating and in some areas expansion of the network - Ensuring traffic safety is a top priority

4.6 Reform proces

The process of reform or reorganization of the administration of roads has followed different tracks in these three countries. Though in all of them the general goal seemed to be to shift towards what New Public Managements theory considers a more efficient way of organizing procurement of public infrastructures; the specific drivers or triggers for starting the process as well as the specific practices that have been implemented in these countries, are different. Table 4.13 shows the main differences and similarities of the process of reform in these three countries.

4.6.1 Differences in reform processes

The reorganization of the road sector in Finland had its origin already in 1992 when the economic recession created a window of opportunity for the NPM paradigm. Already since then the top management of Finnra was promoting a change. A reform proposal or suggestion was made internally in Finnra by a group of initiators and this was later in 1996 presented to Parliament. Parliament rejected it because of the strong opposition of the Labour Unions, the Communist Party and the Social Democrats, which were the dominants parties in the Finnish Parliament then. The decision of parliament did not stop the initiators of the change. The years between 1998 and 2001 -when finally approved by Parliament- were a period of intensive preparation to achieve a smooth transition, if the three laws required were approved in Parliament.

Meanwhile what created the window of opportunity or sense of urgency to change in the Netherlands appears at first to have been the 2001 fraud scandal in the construction industry. Though there was already an ongoing process of reform, the scandal

Table 4.13: *The reform process in the Finnish, the Dutch and the Spanish case*

REFORM PROCESS	Finnish Case	Dutch Case	Spanish Case
ORIGIN	Crisis or window of opportunity		
	Year 1992, Economic recession	Preparatory phase started in 1999, accelerated by:	Year 70s First concessions-abandoned in 1982
	Roads: 1996 - proposed and accepted in 2001	Year 2001 Fraud Scandal in the construction industry	1996 Backlog plus financial deficit and EU requirements → renewed concession model & use of pre-financing
		2002-2003 Parliamentary inquiry of the construction industry and measures from central government	
ROAD REFORM	YES	PARTIAL	NO
	FINNRA (Agency)	RWS[a] (Agency)	Ministerio de Fomento & provincial authorities
	Finnish Road Enterprise	No Public Enterprise	No public enterprise
DRIVERS	Cost cutting	Reduction of staff	Financial Deficit plus need of infrastructure
	Reduction of staff	Breaking old "agreement" system of contractors	
INSPIRATION	Sweden (first)	United Kingdom	Pioneers, maybe some inspiration in France & lately UK (shadow model)
	New Zealand (relationship with industry)	(International partnership project with Belgium)	
ACTORS	Minister of Finance: against PPP	Minister of Finance: promoting PPP	1982 socialist government - same government now promoting shadow tolls
	Top management of Finnra: key leadership made it independent development	Initiators spread throughout RWS - no clear leader	1996 conservative government (Partido Popular)
			Regional governments
CONTRACTORS	Small: against (EU Lobbying) and bigger: PRO		Local contractors working with larger contractors in temporary consortiums (UTES)
		Appear more poractive than in Finland	
		Possible explanation: more experience internationally (i.e. PPPs in UK market)	
COMPLAINTS / OBSTACLES	Changing too quickly	Too heavy sanctions	
	Right of Way procedure		
	EU in general proactive Nevertheless, EU regulation facilitates impugnations of contract award decisions		
GENERAL MODEL	EXPLICIT AND CLEAR-CUT PROCESS	NOT SO EXPLICIT, CONSENSUS BUILDING → SLOWER PROCESS	PROCESSES IN PARALLEL, DIRECTION CLEAR FOR CONTRACTORS
	Small agency	Large agency	Different cooperating authorities

[a] also responsible for water management

about collusive behaviour in the sector triggered an open political discussion about the tendering practices of the sector, and therefore accelerated the process. Some experts are of the opinion that the same event could have also stopped the ongoing reform process. Since 1995 the Ministry of Finance started to promote changes in the organization of government institutions, between 2005 and 2008 about 40 government services were given more independence by converting them in agencies. This process was slowly starting also within the Ministry of Transport, Public Works and Water Management (Ministerie van Verkeer en Waterstaat) and in 1999 a centre to promote the use of Public Private Partnerships was created within the Ministry of Finances. Within the Ministry of Transport also had started by then a process of learning and preparation for the implementation of innovative contracting practices -like the development of standard procedures- but it was the scandal and the findings of the Parliament Inquiry of the construction industry in 2002 what set the stage for more operational choices.

A first corporate procurement strategy for the period 2004-2008 was published July 2004 and Rijkswaterstaat (RWS) became officially an agency officially in January 2006. It was in fact the last organization within the Ministry to be privatized or had become an autonomous administrative authority (zelfstandig bestuursorgaan -ZBO) or a departmental agency; after the Dutch Railways (NS) was privatized; the railway manager (Prorail) became a ZBO; and the national institute for weather, climate research and seismology (NKMI) became an agency.

The new procurement strategy is also seen as a way to break with the old system of drawing up agreements between contractors, by making contractor selection less predictable, increasing the distance between the government authority and contractors and promoting more innovation in the sector.

The use of private financing has a longer history in Spain; where the first concessions date back from the 70s, nine of the twelve original concessions continue to have a major role in Spain's road network. The model was abandoned in 1982, a decision taken by the socialist party - Partido Socialista Obrero Español (PSOE) who was then in power. Nevertheless in 1996 the backlog in transport infrastructures -compared with other European countries- as well as the strict financial requirements of the European Monetary Union, created a window of opportunity for the conservative party -Partido Popular (PP)- to bring the use of private financing back in use and make the necessary legal reforms to implement a renewed concession model in the market.

The main difference between the three cases is that Finland did experience a total restructuring of the sectors, while the others did not. In other words, an institutional reform or organizational restructuring that separated client (Finnish Road Administration) from producer (Finnish Road Enterprise). Such a separation did not occur in the Netherlands, where the reform meant only more financial autonomy for RWS by making it an agency. Meanwhile in Spain no formal restructuring of the government authorities took place. The Ministry of Public Works (Ministerio de Fomento) remained directly responsible for the national road network. Meanwhile for regional

roads, the roads departments within each of the regional autonomous governments, remained responsible of this task; transferred to them already since 1982 when a nation wide process of autonomy and decentralization took place.

All in all the reform process in Finland could be characterized as a more explicit and clear-cut process while in the Netherlands the reform has been realized at a lower speed and with more caution. De Jong and Äijö (2001) characterize the road maintenance liberalization in the Netherlands as "the cautious way" where developments (not only in roads but also in other utility sectors) evolve incrementally and cost reductions have not been achieved. The Spanish reform is to be compared with the Finnish in speed and in clarity of direction towards the market players; however it differs from the Finnish case in the variety of models developed. Since the responsibility of the highways network is divided between Ministry and regional autonomous governments, slightly different models have been developing in parallel, where often some autonomous governments have been the first to introduce innovative contracting practices.

4.6.2 Common lessons

First, an important driver or general philosophy has been to implement practices that reduce the personnel of the agency needed, at least in Finland. This driver is also valid for the Netherlands, the Business Plan of RWS 2004-2008 mentions explicitly and often that the main challenge and what has been commissioned to RWS is to work differently, meaning "more quality with less people" (meer kwaliteit met minder mensen). In fact personnel reduction was the only "hard" goal set for the reform; a reduction of approximately 2000 employees before 2008. This motivation has proven to be more important in practice than other concerns like increasing innovation or even keeping total costs as low as possible. Maybe this is the case because this is an aspect easier to quantify and track down. Side effect of this philosophy has been an increase of the number of consultants working for the agency. They carry out all kinds of preparatory work or studies and quality monitoring tasks as well. In the future it is expected that only tasks that require authority -a resource unique to the government- will be left in-house. The presence of this side effect has also been observed in Spain, however it should be noted that personnel reduction in itself has not been an important driver of the Spanish reform.

Second, developments in neighbouring countries as well as successful experiences elsewhere have also proved powerful in inspiring new practices, but foremost to bring the issue of the need of a reform in procurement practices, to the front of the political arena. In this aspect is Spain again somewhat different. They have in fact developed an own model and till recently in relative isolation from the Anglo-Saxon model, which is the main source of inspiration for North European countries. They can therefore be considered real pioneers in the introduction of concepts like private financing and direct concessions.

Third, actors and their positions have been shown to be decisive for the final choices made. While in Finland, the opposition of the minister of Finance to private financing has impeded to some extent the use of Public Private Partnerships, in the Netherlands the same authority has promoted its use and achieved a significant use of this scheme in large capital projects. Groenewegen and de Jong (2008) in their study of the case of Road Management Liberalization in the Nordic Countries, claim that in not in all circumstances will the most efficient structures emerge as predicted by Transaction Cost Economics, but path dependency and power relations will largely determine the outcome of the process. In fact, multiple institutional equilibria exist, some of which are clearly economically suboptimal.

In the Spanish case the political orientation of the ruling party has had an even stronger effect on the decisions being taken than in the other two cases. In this respect, it is interesting to note that besides the position of the different actors, two other aspects play a role in the final choices made are, the way actors create their opinion and the relative balance of powers between them. To illustrate these two aspects we cite two examples. First, the perception of private financing and public private partnerships (PPP) that left parties have in Spain is almost contrary to the perception that the same parties have in the Netherlands. In the Netherlands, parties like the Dutch Labour Party (PvdA) and the Socialist Party (SP) believe that the use of PPP schemes actually increase the transparency of the decision making process and better ensures the fulfilment of public values; while the PSOE in Spain tends to revert private financing initiatives and shift back to budgetary financing of infrastructures for the same reasons. Second, the fact that RWS and the Ministry of Transport, Public Works and Water Management have relative equal power than the Ministry of Finances - which is different than the situation in Finland or UK where the Ministry of Finances has more power- has meant that technical quality and risk management aspects have taken a more important role in the Dutch reform model than financial goals.

Finally, EU regulation is considered by all governments as promoting the use of these open tendering and new outsourcing procedures. Nevertheless, it also seem to facilitate to contractors the opening of legal disputation processes or claims to the tendering and selection decision of the road agency; and therefore slow down the implementation of practices that would allow more design freedom and innovation. The Spanish case differs slightly in two respects. First, EU regulation has been a concrete obstacle for the implementation of the so called public concessionaires, at least in the original format where the idea of the government was to win more flexibility and be able to procure and tender more tasks without having to comply with all the requirements demanded for public tendering. Second, though some complaints have indeed been filed by market players, this trend is less significant as in general contractors accept that selection process is not 100% objective and the possibility of having less chances in future tendering procedures would probably deter them from starting a legal process against the government authority.

4.7 Challenges and dilemmas

The analysis of these three national procurement systems, their evolving process and specific nuances that have resulted in a particular mix of contracting practices and plans for the future; have contributed to a better understanding of the problematic at play in each of them. It appears that important challenges remain for all of these countries.

4.7.1 Challenges Finnish case

The most important challenges for the organization of the management and procurement of road assets in the Finnish context seem to be:

First, the profit levels of the sector -especially in routine maintenance- are low and could threaten the well being and sustainability of the industry or at least prevent significant investments in research and development, therefore affecting the competitiveness of the national contractors in a wider European market.

Second, the possible integration of routine and periodic maintenance activities in one contract may prove more difficult than expected since there are important technical barriers -different technologies and skills - and since it may result in a further process of market concentration, leaving too little competitors able to perform well in such contracts.

4.7.2 Challenges Spanish case

Meanwhile the most important challenges ahead for road authorities in the Spanish context seem to be in the implementation of performance indicators or performance requirements upon which payments are conditional and the building of more incentives for competition and increase of efficiency in the market.

4.7.3 Challenges Dutch case

Other issues seem more urgent in the Dutch context:

The first issue relates to an appropriate distribution of risks. Contractors perceive current sanctions as too heavy and claim that for certain kinds of systems 100% reliability is almost impossible to achieve and the associated risks very difficult to quantify and control. In response they may charge fees that reflect more that of insurance costs. The question arises whether 100% reliability may be too costly for taxpayers. It may be wiser and cheaper, either for the agency to assume certain kind of risks or to place them in the right market, like the one of insurances.

Second, in the development of standard routine maintenance contracts close attention needs to be paid to establish the right size or scale, and combination of tasks to be

included in the contract, if savings are to be achieved. Including all tasks may not be the best, since there are certain systems like lighting that prove more cost-efficient if outsourced as a single contract for the whole country, apart from all the other routine maintenance tasks.

4.7.4 Common challenges and dilemmas for the future

Common issues requiring attention in all countries are:

First, the issue of market concentration; all in all these innovative practices seem to concentrate the market in a few large players and the question remains whether soon the savings in transaction costs and economies of scope and scale, will turn around as contractors have more market power and are forced by low profit levels to start acting on their defence.

Second, it has been observed that design freedom remains limited even in the most innovative projects. In all countries there seem to be formal and regulatory obstacles for granting more design space to contractors. Nevertheless, there are also informal institutions, like the attitude towards the management of uncertainty and dealing with change requests from contractors that also play a role in limiting this space, especially in Northern Europe. The design freedom granted and the flexibility that results from this kind of innovative contractors appears to be even more limited in Finland and the Netherlands also since market or traffic risks are not transferred to contractors. Possible improvements could possibly be achieved by implementing procedures of unsolicited proposals[8] and competitive dialogues[9].

The third question, valid for Finland and Netherlands, the two countries where toll roads are not part of the scheme, is whether all these innovative practices and the new incentives indeed help to change the adversarial relationship between principals and agents, and the rent-seeking behaviour of contractors. Or do they need to go further and place market or traffic risks also in the hands of private sector like is done in Spain, so as to finally achieve real entrepreneurial behaviour from contractors?

Finally, as mentioned before, the reform of the periodic maintenance sector remains a challenge for all. Which are the best ways to operationalize this change towards more

[8] An unsolicited proposal is a written proposal for a new or innovative idea that is submitted to a public agency on the initiative of the offering company for the purpose of obtaining a contract with the government, and that is not in response to a specific invitation to tender.

[9] A competitive dialogue is a public-sector tendering option that allows for bidders to develop alternative proposals in response to a client's outline requirements. It is for use in the award of complex contracts, where there is a need for the contracting authorities to discuss all aspects of the proposed contract with candidates. Such dialogue would not be possible under open and restricted procedures. Main features of this procedure are: dialogue is allowed with selected suppliers to identify and define solutions to meet the needs and requirements of the contracting authority; the award is made only on the most economically advantageous tender criteria; and dialogue may be conducted in successive stages, with the aim or of reducing the number of bidders.

performance and service like contracts? Will public authorities let go their control over bridges and their design? Will programming and planning be outsourced to the same contractor or to consultants? If contractors are given more freedom will they act opportunistically? Or conversely will these contracts result in more trust? Chapter 6 presents a gaming-simulation developed to explore some of these questions.

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Chapter 5

The global agenda versus the national agenda

Parts of this chapter have already been published in: Altamirano and de Jong (2009).

5.1 Introduction

Roads are technologically and institutionally less complex than other infrastructure types. Rolling stock consists of buses, lorries, taxis and private cars -all of which are owned by others than the infrastructure manager. Neither is the underlying technology for producing asphalt, maintaining it properly, eliminating ice, snow and other disturbing elements from the road surface exceedingly complicated. And yet road reform is in the context of growing car use and congestion, budgetary restrictions, environmental considerations and lacking technological innovation in the past decades, a subject to be reckoned with.

Several organizations have a large role to play in the debate on the why and how of road reform. Examples of these organizations are the World Bank, the Organization for Economic Co-operation and Development (OECD), the European Union (EU) and the World Road Association (PIARC). More often than not, individual countries take the sketches of models to be emulated as reference frames for how to restructure the institutions for their own road management system. One could say that among experts and policy-makers in the international arena and transfer agents carrying ideas from international organizations to the national scene and vice versa, a worldwide pool of ideas on road reform exists from which national governments can borrow. For instance, the World Bank emphasizes that public policy in roads requires a thorough restructuring of the existing public agencies involved. This implies entering new paradigm, in which public agencies are transformed into a client organization respon-

sible for tendering all phases of road construction and maintenance activities (Parkman 1998, PIARC 1995, Talvitie 1996; 1999).

This process of moving from an in-house organization to a client organization is often referred to as the privatization process of a governmental agency (Madelin and Parkman 1999, Pakkala 2002). The process is described as existing of seven phases that increasingly separate the client-related aspects of road management from its service-providing parts (see Figure 5.1). In this terminology, the client represents the principal, for instance the public agency ordering the services, while the provider is the agent, the company that delivers the requested services. This is accompanied by a gradual opening of the market (liberalization), the selling out of the public provider (privatization), the creation of a road fund from which investments exclusively to roads can be made and eventually even the privatization of the public agency acting as a client. However these last two phases of the model have not yet been implemented anywhere.

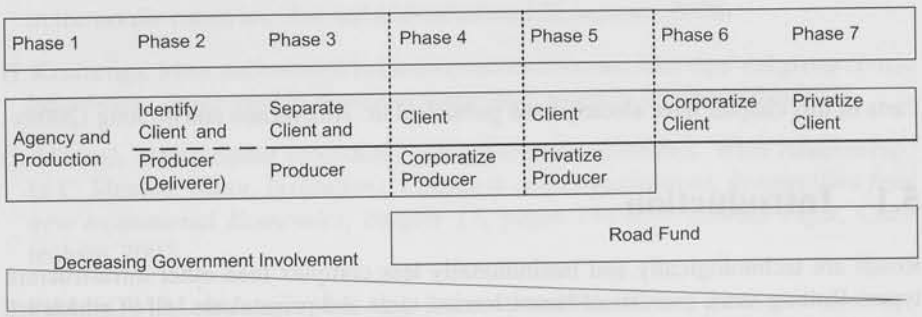

Figure 5.1: *The seven phases in road reform. Source: Talvitie (1996, 100), adapted by Pakkala (2002, 17)*

Not only do the proposed phases in the reform seem fairly standardized, so do the objectives and drivers to engage in such a reform (Dunlop 1999, Talvitie 1996, Heggie 1999). According to the World Bank:

> The objective is nearly always the same. To introduce a more commercial approach to management of roads, by creating: (i) more autonomous and accountable management; (ii) a more market-based approach to setting priorities; (iii) better staff incentives; (iv) a more flexible staffing structure; and (v) better accounting systems combined with tighter financial discipline (World Bank 2007).

As pointed out before, four trends seem dominant in road contracting (Altamirano and Haraldsson 2005, Altamirano and Herder 2006). Firstly projects are contracted for the whole life cycle of the road. Secondly contractors are given increasingly more freedom of design (Herk et al. 2004), as the indicators used for monitoring their work

become less operational and more performance based (Cervera and Minchin 2003). Thirdly more projects are financed by private investors (Miller 2000). Fourthly contracts tend to be granted for the longer term (Altamirano et al. 2007). Britain, New Zealand and Australia are presented as leading, because they materialized most of these trends. Other countries are seen as lagging behind them, but still following largely the same developmental path, albeit slower and later. This would suggest that road reform occurs more or less uniformly around the world, with countries following the same steps.

In this chapter, it will be demonstrated that the institutional starting positions of various countries can differ so markedly that they are bound neither to follow the same developmental paths nor to produce similar institutional outcomes after the reform. Put differently, multiple institutional equilibria exist, which result from different starting positions leading through different histories of interaction between players to different institutional equilibria (Aoki 2000; 2001; 2007, Groenewegen and de Jong 2008).

While Finland, Norway, Sweden and the Netherlands have no or little experience with funding road infrastructure through toll-levying or transferring the financial or managerial responsibility of entire projects to private parties, in Spain, Portugal, France and Italy road users are accustomed to paying for the use of infrastructure because these countries have a long-standing tradition in private or mixed entrepreneurship and finance in road construction and maintenance. As a consequence, the reform process of liberalization, privatization, private finance and growing design freedom for contractors puts very different types of strains on these countries. The steps taken to push through the reform as the policy-makers in each of the countries defined it, also diverged. Although each of the above mentioned countries have their individual features, it is justified to make a broad-brush distinction between the Scandinavian, the Continental European and the Southern European models of road reform; apart from the Anglo-Saxon model, as indicated for social policy models (Esping-Andersen 1990).

In order to demonstrate the different starting positions, developmental paths and eventual institutional outcomes after the reform process, three countries have been selected -Finland, Spain, and the Netherlands- seen as reform pioneers within their general group. For all three countries, the institutional situation before and after the reform will be presented, after which the specificities of all developmental paths are laid out, as well as what ideas were borrowed from the worldwide pool of ideas for reform. Finally general conclusions are drawn in light of the main research question on different developmental institutional paths.

5.2 The road sector and its reform agenda

The public obligation of providing a transportation network can be divided in four different kinds of tasks: capital projects, the construction of green field projects or new

roads; routine maintenance, which includes daily activities that ensure the continuous availability of the road, like roadway and shoulder maintenance, drainage and winter maintenance; periodic maintenance, the management of pavements and the planning of activities required to return the state of the road to its original condition by repairing road damage and thereby substantially altering the asset condition and finally; and operation of roads, which mainly includes incidental traffic and safety services.

Figure 5.2: *Agenda for road management reform*

In general the agenda for reforming the road sector can be described as follows. Firstly there are two overarching goals, to introduce a more commercial approach to road management and to ensure an adequate and stable supply of funds to the road sector. These goals can be achieved by applying different policy measures (see Figure 5.2), such as introducing a "more flexible staffing structure" (Heggie 1999, 41) or the introduction of the user pays principle (Estache et al. 2000, Heggie and Vickers 1998). In some cases, normally when the road authority counts with a large operational division, carrying out construction or maintenance work directly, the implementation of these principles requires restructuring the existing road agency.

This can be achieved by creating a vertically integrated government agency under the supervision of the Ministry of Transport (corporatization); by transforming the entire road agency or road administration is into a user-financed service-producing state owned enterprise (SOE) with a contract-based relationship with the government; and by unbundling production from regulation. The last option involves the creation of an administrative road authority (ARA) taking care of regulation, and a separate

service-providing SOE, carrying out construction and maintenance tasks. The seven phases model depicts the implementation path for this last reform option.

Apart from an internal reorganization, the application of these measures normally also requires a reorganization of the work packages or services to be outsourced. This is how different countries have come to experiment with innovative contractual arrangements for the procurement of road construction and maintenance.

5.3 New governance modes

These innovative practices have caused a shift in governance from a public bureau to a market-like arrangement. In the old situation the public road authority did outsource but did so by tendering work orders. Contracts were signed directly with each contractor. The road authority had its own staff looking after the management and coordination of all project activities. Private parties only acted as a hired hand in the public sector (Salminen and Viinamäki 2001). In the new situation, the road agency signs a single contract for an entire project or a service agreement for a particular network for a particular time-span. Subcontracting of specialized works or particular work orders still occurs, but now under the responsibility and supervision of the main contractor. The new role of the private contractors is that of a service provider (see Figure 5.3).

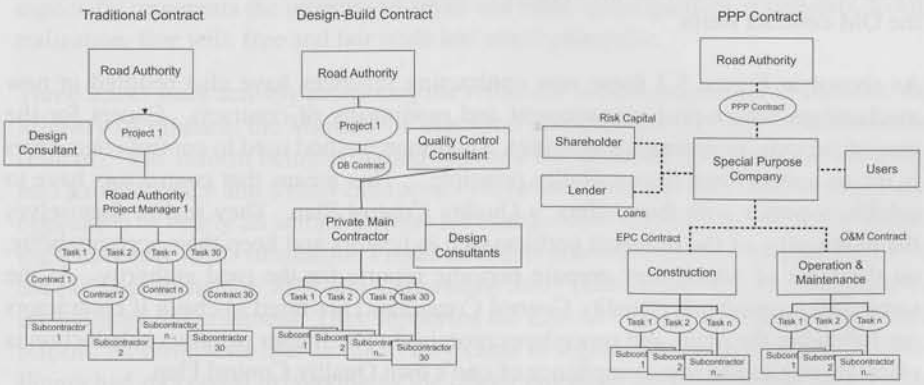

Figure 5.3: *Old versus new organization of contracting entities*[1]

The first column shows a traditional design-build-build (DBB), whereas the second represents the common structure for a design-build (DB) project. In a DB contract, design and construction aspects are contracted for with a single entity known as the main contractor, usually the general contractor; but in some cases it is also the design consultant. Where the design-builder is the main contractor, the design consultants are typically hired directly by the contractor. By making both phases overlap the road

agency or infrastructure owner aims at minimizing project risks and delivery times; by allowing the construction contractor to bring his construction expertise into the design process; cutting the extra tendering process for the design phase and realizing payments upon completion. Besides functional requirements, instead of technical requirements, are used in combination with lump-sum payments -an up-front negotiated total price for the whole project, instead of unit prices-, ensuring the owner against cost variations. Integration of different life cycle phases and use of functional requirements in contracts entail larger design space for contractors, freedom to choose different technical solutions.

The third column is illustrative of a public-private partnership (PPP) or concession contract. All life cycle phases of the infrastructure are tendered in a single package. The main contractor, often a special purpose company, finances the project and takes care of design, construction, operation and maintenance of the infrastructure for a certain period of time, between fifteen and thirty years. Payment is subject to completion and linked to performance, during the operation period. Practically all technical risks are shifted to the main contractor. The main contractor subsequently manages his risk efficiently by closing an engineering-procurement-construction (EPC) and an operation and maintain contract (OM) with experienced suppliers, often daughter companies. The EPC contract is similar to a DB, but here both parties are private. Upon completion of the project a functional completion certificate is issued and the infrastructure is transferred from the supplier to the main contractor. From that moment on the OM contract starts.

As shown in Figure 5.3 these new contracting practices have also resulted in new mechanisms for ex-post management and monitoring of contracts. Except for the case of periodic maintenance activities, a common method used to control contractors is the so called "own responsibility principle". This means that contractors have to submit, together with their offers, a Quality Control Plan. They realize themselves the monitoring of the different performance indicators and keep their accountability, on the basis of which they prepare periodic reports for the road authority. At the same time, consultants (Quality Control Consultant) are hired to check if contractors are following the plans and procedures promised. The higher penalty or deduction is often the one due to non-compliance of one's own Quality Control Plan.

Though these common structures are representative for the situation in all three countries; one could say that the Spanish situation is richer in variety than the Finnish and the Dutch one. While many of the life cycle contracts like Design-Build-Finance-Maintain-Operate (DBFMO) are realized by concessionaires that are totally vertically integrated; the typical Anglo-Saxon contractual model of managing agents or consultant companies that contract out each part/stage in a competitive way is now being copied by the Public Companies or Public Concessionaires that many local authorities have set up.

5.4 The institutional setting before the reform

In the road sector in Spain, Finland and the Netherlands, what institutional structures existed before they were reformed. To answer this question, the main actors will be presented, the positions they had in the system, their preferences vis-à-vis the reform and the institutional rules and practices in existence then. Since road reform hinges strongly on government action and party-political preferences, extra attention will be paid to this aspect.

The main actors in all countries are the national government, the ministries of finance and transport, national road authorities, national large and small contractors, consultants and banks. To better suit the Finnish case labour unions have to be added to this list, while for Spain regional governments, users and concessionaires.

5.4.1 Actors and their positions in Finland

In Finland the main political parties are the Social Democrats (SDP), the Centre Party and the National Coalition. In 1996 and in 2001, when the three laws needed for separating Road Administration and Road Enterprise were finally approved, each of these three parties had approximately 25 per cent of the votes. The SDP predictably was closest to the labour unions. The National Coalition, a centre-right party, represents private enterprises and the business community. Meanwhile the Centre Party especially represents the interests of small and rural municipalities, it supports decentralization, free will, free and fair trade and small enterprise.

Three actors were actively promoting the reform of road management in Finland: the Ministry of Finance, the Ministry of Transport and the Finnish Road Administration (Finnra). The reform being proposed required the unbundling of the road authority into a road agency and a road enterprise. Therefore it initially met with criticism and opposition of nearly all actors. Drivers for change were basically to cut public spending and reduce staff. In addition Finnra aimed to promote innovation in the sector. In the political arena, the SDP and Communist Party (Left Wing Alliance) represented the majority in Parliament. They supported the Labour Unions and therefore opposed reform. Nevertheless, later in 2001, they came to approve the laws required, because Finnra had succeeded in convincing the labour unions of the benefits that the creation of a public enterprise will return to them.

Finnra also faced internal criticism. Staff at the operational level was hesitant to transfer so much design freedom to private contractors. It felt like difficult to them to go from being project managers telling contractors what and how to do things; to contract managers only having a say in the acceptance of the final quality delivered. Labour Unions came in defence of their affiliates. The creation of a separate public enterprise that would compete as any private company threatened the jobs of many workers within Finnra. They were externally backed by the left-wing political parties.

Consultancy firms were moderately opposed: they had their doubts as to the speed with which the reform would be pushed through. They also feared to lose their role as privileged advisors and become only sub-contractors of construction companies. Road contractors in general were against the reform. Large contractors feared more competition, especially from foreign companies and the new public enterprise. Medium and small contractors feared to become subcontractors, losing their direct contracting relationship with Finnra. Meanwhile other contractors active in construction but not yet in roads feared unfair competition from the large enterprise to be created. Foreign contractors were the only private players interested in the reform. Swedish and other foreign players wanted access to the Finnish market. The position of the banks seemed neutral.

All these parties had a stake in the problem and key resources to either block the reform or ensure successful implementation. Examples of the former were labour unions, political parties represented in Parliament and the Ministries of Transport and Finance. Among the latter are considered the contractors, consultants and the staff at Finnra. Contractors not yet active in the road sector are an interesting case; not being directly involved, they could not stop the reform but were key for the creation of a new market for maintenance activities. If they had confidence in the reform they would deploy their expertise and resources in order to become active in this market.

5.4.2 Actors and their positions in Spain

In Spain the two main political parties are the conservative Partido Popular (PP) and the social-democratic Partido Socialista Obrero Español (PSOE). Together they represent over 80 per cent of the votes. In addition there are two parties representing regional interests, the Partido Nacional Vasco (PNV) for the Basque Country and Convergencia i Unio (CiU) for Catalonia. The PP was the main opposition party until 1996, while the PSOE was in power. The roles were reversed between 1996 and 2004. The PSOE won the elections again and regained power in 2004. The two other regional parties support one national party or the other, depending on their support for greater regional autonomy.

The initiator of the reform was the recently chosen PP government. This government supported by the Ministries of Transport and of Finance, declared privatization as one of its main objectives. It proposed, for public roads, to go back to the concession model; an alternative quite in line with its drive for privatization. An ally in this particular issue was the PNV, which was aware that neither the national state nor their region could control roads under concession.

The political arena was far from agreement on the issue. Like in Finland, strong opposition was shown by the left wing parties, PSOE and the CiU, who had then a majority in parliament. The reason was, however, different. In Spain they represented the interests of the smaller contractors instead of the labour unions, which believed the

new practices would favour large vertically integrated companies, increase their profits, lead to higher market concentration and leave small contractors subject to abusive contract terms. Furthermore they were against a longer duration of project concessions, the extension of existing concessions and pre-financing and/or toll-financing of roads. They feared public control over expenditure would be lost. For the CiU an additional concern was that national players would gain control over regional roads.

Compared to Finland, private players, large contractors and concessionaires (having the expertise and financing capacity to compete in the proposed model), banks and consultants seemed more favourably inclined. However the position of road users was mixed. They were both unhappy to see the numbers of toll roads increase, while acknowledging the need to augment investments in the road network.

5.4.3 Actors and their positions in the Netherlands

There are two factors that complicate the drafting of positions towards the reform in the Dutch case. First, there has been no clear starting point of the reform - 2004 when RWS chose for the "Market unless" philosophy and drafted it first procurement strategy or 2006 where RWS became an agency[2]. Second, and most importantly, the reform as a whole and its meaning were never clearly and explicitly announced or conveyed to the different stakeholders by the government authorities. Therefore, their reaction has also been rather ambiguous and it is not possible to draft a clear position toward the reform as a whole, but only their positions towards certain issues "perceived" by some of them as salient, like the increasing use of PPP contracts.

The Netherlands has a multi-party system, with numerous parties in which any one party has little chance of gaining power alone. Therefore all governments are nearly always coalitions. There are twelve parliamentary parties but the largest four according to their number of seats in the first and second chambers are the Christian Democratic Appeal (CDA), the Labour Party (PvdA), the Socialist Party (SP) and People's Party for Freedom and Democracy (VVD).nThe CDA is a centre-right Christian democratic party that in terms of government intervention place itself between the individualism of the VVD and the statism[3] of the PvdA. The PvdA is a social democratic party with a left orientation, but to a lesser extent than the so called Socialist Party (SP) and it is therefore considered a centre-left party. Although called the Labour Party, in fact it has no formal links with trade unions. The SP is a left-wing party that since 1991 has dropped its communist course and has chosen a more independent and less radical socialist course. Finally the VVD is a conservative liberal party seen as the most right wing of the major parties.

Though strong leadership has not been observed from any particular actor, there are

[2]For more information see Chapter 4.

[3]Merriam Webster defines statism as a "concentration of economic controls and planning in the hands of a highly centralized government."

few actors that appear as initiators of the two main issues of the reform. The first issue concerns the promotion of PPP or DBFM contracting scheme in general for all public infrastructure sectors, which started already in the late nineties. The main promoter seems to be the Ministry of Finance supported by the central government and in the political arena, the right-wing party VVD.

The second issue concerns the internal reorganization of RWS, first with the introduction of "the market unless" philosophy with the drafting of the first procurement strategy for the period 2004-2008 and second the change from a department of the ministry to an agency in 2006. This second development was already underway government wide. RWS itself seems pro-reform aiming at more financial independence but it did not play a particularly leading role in this respect. The proposed restructuring counted with the support of the Ministry of Transport, Public Works and Water Management (VenW). With the creation of an agency as well as with the introduction of new contracting practices as proposed in the first procurement strategy (2004-2006) the Ministry had also an special interest in downsizing the number of employees working in public sector. The downsizing of RWS in approximately 2000 employees by 2008 was the only hard goal set for the reform.

Meanwhile, mixed signals were given by the Minister of Transport between 2004 and 2005 about her belief in PPP schemes and private financing. The position of the government has also been put in doubt by different stakeholders (mainly banks and contractors) in July 2005.

The private sector in the Netherlands follows in general terms the same pattern as discovered in Finland and Spain. Larger contractors see an opportunity in life cycle-wise integrated contracts and in DBFM contracts particularly; meanwhile smaller and medium contractors possibly would have preferred to keep business as usual. Besides national contractors, no clear standpoint of consultants as well as foreign contractors could be observed. Finally on the issue of private financing, banks were as expected to look forward to the opportunities this new market would bring to them. Nevertheless they were disappointed as time passed and this government intention did not materialize.

Like in Spain Labour Unions have not played an important role in all these changes, since the reform did not imply a restructuring of the road agency. Nevertheless the reform did aim at the reduction of the personnel of RWS by approximately 2000 employees and one would expect a reaction from Labour Unions and possible from the political parties that support them. But it is here that one notices an important difference between the Netherlands and Finland and their institutional context. Labour Union density[4] in the Netherlands is less than one third (22.3) union density in Finland (74.1). The Netherlands is in this respect nearer to Spain where union density is

[4]Union density rates are defined as defined as union membership as a proportion of wage and salary earners in employment. Source: Visser, J., "Union membership statistics in 24 countries", in Monthly Labor Review, Vol. 129, No. 1, January 2006, available at: http://www.bls.gov/opub/mlr/2006/01/art3abs.htm.

as low as 16.3. Therefore their power is relatively weaker in the Netherlands than in Finland, but stronger than in Spain.

5.4.4 The institutional framework in Finland, Spain and the Netherlands

Before the reform was initiated by all countries, in the late 1990s (for Finland and Spain) and around 2004 in the Netherlands; they followed the traditional procurement model. Operation and maintenance tasks were realized mainly by road agency in-house personnel and infrastructures projects were financed directly, with public funds. Outsourcing took place on an ad-hoc basis. Projects were normally divided in small tasks or work packages for which private companies were hired. The road authority was then acting as the main contractor. Given the limited scale of the tasks assigned to contractors, contracts were prescriptive. Ex-post monitoring was done with a focus on the contractors' effort and checking technical requirements. Price was the overruling selection criterion. Contractual relationships were valid for a relatively short period of time, normally the time needed to complete the particular task. And payments were made on the basis of unit costs. This system was designed under the principle that all operational risks and the entire responsibility towards users were to be fully and directly borne by the public authority.

There were also important differences between the Finland and Spain before the reform. In 1996 the Finnish Road Authority still fully operated the routine and winter maintenance tasks in-house. It had no recent experience with private financing methods. Meanwhile, in Spain, at least 40 per cent of the maintenance tasks were outsourced; and, in exceptional cases, the road authority could even make use of the traditional concession model developed in the late 1960s.

The situation in the Netherlands before 2004, is somewhat in between the Spanish and the Finnish cases. Resembling Finland, it had practically no recent experience with private financing methods, except for two tunnel projects delivered under a shadow toll scheme in the late eighties. Resembling Spain, it was already outsourcing a considerable proportion of its maintenance tasks.

5.5 The institutional setting after the reform

Here the institutional structures which prevailed after the reform will be described. The main actors in countries are roughly the same as before the reform, except for the newly created state-owned Finnish Road Enterprise (FRE).

5.5.1 Actors and their positions in Finland

Actors and their positions have been shown to be decisive for the final choices made. The opposition of most of the stakeholders made it last ten years before the required

legislative changes were approved. The reform succeeded mostly due to agile negotiation with stakeholders by Finnra. Before the reform, support from the Minister of Finance was key to place the issue on the political agenda. Later on that same actor became the main obstacle for a wider scale implementation of private financing.

In Finland, once the reform had been implemented and the different stakeholders experienced the new system, they came to adopt different positions. In general they were satisfied with the process, especially public bodies such as Finnra and the Ministries of Transport and Finance. These had realized their goals, including downsizing of the road agency and the creation of a competitive market for routine maintenance. They even intend to copy and implement the same model to other infrastructure sectors, such as the railway sector. Most of the actors have adjusted to their new role. Finnra has become a professional client. The workers represented by the labour unions are pleased with their status as staff of a successful autonomous company. The FRE is the largest contractor with a competitive advantage over its competitors, because its experience and familiarity with the client. However recently it has lost some market share in routine maintenance activities to other companies such as YIT, a construction company especially active in the area of water and environmental services that joined the newly created market of routine maintenance in 2001.

Contractors have learned to compete in the new maintenance market and have become service providers. Foreign contractors have been more successful in obtaining capital projects than in gaining maintenance projects. Skanska, a large Swedish contractor, has been the leader of the winning consortium for the only two PPP projects till now realized in Finland, the E-75 and the E-18 motorways. Medium-sized contractors appear to be the biggest losers after the introduction of the large innovative contracts. They do not have the financial strength needed to act as main contractors, and are often less specialized than smaller contractors, which makes becoming a subcontractors hard. Meanwhile most consultants have become partners rather than sub-contractors. Some of them are even developing long-term alliances with contractors. Others have specialized as quality auditors of contractors' work.

However, when specific future developments are discussed, disagreements pop up again. While Finnra would like to transfer more responsibilities to the private sector by promoting private financing and the use of large integrated PPP schemes, the Ministry of Finance and Parliament are halting this development. They either fear to lose control over future spending or simply do not believe that total life cycle costing saves moneys. Large contractors instead lobby for further implementation of these innovative practices, because comprehensive long term contracts grant them more design space. Their complaint about the implementation of private financing, thus far, is the uncertainty about the number of future projects using this scheme. They believe a larger pool of projects, announced long in advance, is crucial to ensure the participation of more contractors, since tendering costs are much larger and companies need to invest in a set of completely new skills.

5.5.2 Actors and their positions in Spain

The position of the actors in Spain is not only influenced by the results of the reform but also by the change in government in 2004, with the Socialist Party gaining office again. The main opponents in 1996, PSOE and CiU, came to realize that even though they are now a parliamentary majority, it is practically impossible to revert to the concession model and shift back to budgetary financing of infrastructures. They now opt for supporting shadow-toll model instead of direct toll-levies. Shadow tolls are payments made from public budget to contractors based on estimates of numbers of road users, a price for each of them. The new government is defending this position by pointing at the right of citizens to universal and free access to public infrastructure.

Like in Finland, the results of the road management reform are generally appreciated in Spain. At the national level, authorities like the Ministry of Transport are satisfied with the expansion of the network and its relatively good condition. After 2004 they have begun to make use of shadow toll schemes, where levy is not paid directly by users but by the government. And they are currently replicating the concession model, either direct or through shadow toll, to already existing roads, to finance maintenance expenses. At the regional level, the positions of road agencies depend on the political situation. Most are satisfied with new practices and are also extending the concession model to maintenance. Many also have created Public Corporations that fulfil the role of concessionaires and hire competitive subcontractors for the various life cycle phases, to keep some control over their income from tolls. Large contractors and concessionaries, as expected, are satisfied with the new model. However they are not totally convinced of the shadow toll model, for they miss control over market risks and tariffs and they do not like being used to only finance projects. These new shadow-toll concessions are used in combination with performance-based payment determined by government, which reduces their degrees of freedom and poses new risks.

It is interesting to note that even smaller local contractors have benefited since they can participate in temporary alliances or consortia with large national companies for various local projects. The change has also served the interests of consultants. In fact they were more used to collaboration with contractors than their Finnish counterparts. Concessionaires in Spain are normally vertically integrated and have large engineering departments, from which some consultancy companies evolved. Only some smaller consultancy companies are upset, because of what they consider arbitrary tendering practices by public concessionaires. The financial actors seem pleased: three national banks have been very active in this area of private infrastructure finance and have therefore developed expertise making them competitive on the entire European chess-board. Finally users directly affected by the new model are generally used to the user pays principle, even though they find it sometimes hard to swallow toll charges for already existing roads and for maintenance. Recently a number of pressure groups have shown resistance against the growing number of shadow toll projects, which are believed to lead to much higher expenses in long run.

5.5.3 Actors and their positions in the Netherlands

After the implementation of changes (i.e. creation of an agency, changes of contracting practices and delivery of few projects using PPP schemes), all political parties seem to be in favour of implementing public-private partnerships at a wider scale. In the last two years there seems to be stronger political will to implement more and more PPP projects in the Netherlands. This was clearly shown in a recent Parliament general discussion "PPP in infrastructures" with the Ministry of Transport and Public Works the 5 of November of 2008. During this discussion all political parties demanded from the current Minister of Transport -Minister Camile Eurlings- to show more ambition in this respect. More specifically, the CDA, as well as the VVD and the PvdA agreed that next year (2009) at least three construction projects using PPP schemes should be started. he VVD (right-wing) reminded the rest about the main advice given by the Ruding Parliament Commission and about the main standpoint of the cabinet, the lack of enough deal flow[5].

The Minister is also in favour of more use of PPP and explained during this hearing that the causes for the little knowledge about PPP within the government as well as the problem of too many projects been delayed; are been currently researched. Not only political parties but also the Ministry of Finance and top civil servants within RWS and the Ministry of Transport seem to believe in the potential of PPP to deliver projects on time and with an added value in comparison with traditional project delivery methods.

In terms of political parties and ideologies, it is interesting to note a difference in their perspectives on how are public values best safeguarded. While left-wing parties in Spain and Finland were -as expected- somewhat less favourably inclined to the reforms (i.e. liberalization and/or privatization) and right-with parties served as initiators, nearly the opposite is observed in the Netherlands. In the Netherlands are actually left-wing parties like PvDA, who have pushed or promoted the use of PPP schemes -especially in the last years- as they consider them a way to advance transparency in the decision making process about infrastructure investments; while right-wing parties like CDA have their reservations on to which extent these practices should be applied for preventing harms for medium and small enterprises.

Large contractors share with the cabinet concerns about not enough deal flow in PPP projects to justify the needed investments and develop the expertise needed in-house. As in the first years of the reform in Finland, small and medium contractors are lobbying against these new contracts in the national and European arenas. Meanwhile larger contractors have all started to prepare for their new role as service providers in a "mobility market" and have opened so called infrastructure management divisions,

[5]Not enough deal flow (i.e. pool of similar projects or stream of opportunities to tender as a collective whole) is a key problem for a successful implementation of PPP schemes. As transactions costs and first investments -in new skills and knowledge needed- are quite large, most contractors won't take the risk if the probability to win another project in the future -that cover all the previous losses and learning costs- is not large enough.

a much smaller proportion of small and medium size contractors have started to adapt to their new expected role as specialized subcontractors.

Main complaints from contractors about innovative contracting practices are first, that still too many tenders are awarded mainly on price. Second, while too many projects are being delayed for more than six months -mainly due to regulations about air quality-, RWS expect them to stick to the prices promised. Third, they criticize the lack of uniformity in the implementation of the procurement strategy. Each organizational unit of RWS interprets contracting guidelines differently, so that they do not have to handle with a single client but experience many different ones. Finally, the contractors' main critique towards the new performance-based contracts is that sanctions and deductions are too high and some of them even unlimited. The government is requiring too high availability or reliability levels.

Finally concerning foreign contractors, another interesting difference between the Netherlands and Spain and Finland is noticed. A larger number of foreign contractors have been competing in the Netherlands for DBFM capital projects. In recent PPP projects there have been competitors from France, Belgium, Germany and Spain. Dutch companies that need to serve as local partners seem to like to cooperate with international partners. They often invite international partners with a specific competitive advantage of expertise; like tunnels, or private financing (e.g. Spanish company Dragados). Not only private companies but the government and the society in general seem to be more open towards the idea of having foreign contractors competing in the national territory.

5.5.4 Changes in the institutional framework in Finland, Spain and the Netherlands

Finnra has become a government agency operating under the jurisdiction of the Ministry of Transport and Communications but relatively independent from it. In Spain roads have remained under the jurisdiction of the Spanish Directorate General of Roads, which is part of the Ministry of Transport, and of the autonomous communities. Both countries are comparatively advanced in using innovative contracting and in the implementation of their own reform agendas. While Finland is already implementing its third procurement strategy after the reform of 2001, Spain has refined its contract law to support the further development of the concession model, not only for use in green field capital projects, but also for the rehabilitation and maintenance of existing roads.

Meanwhile in the Netherlands only a mild restructuring of the road authority has taken place as RWS had become a government agency. Therefore the authority exerted by the Ministry VenW is limited to a number of Service Level Agreements (SLAs) to which RWS commits, within an established budget. A second procurement strategy has been presented for the period 2008-2012, but as explained in Chapter 4 the

implementation process of innovative practices is different from the Finnish and the Spanish one. Both procurement strategies or guidelines implement leave great discretion power to the local authorities to decide which contracting scheme and awarding procedure to use, on a project per project basis. The result has been a lack of uniformity in how these guidelines are interpreted and applied by each organizational unit, which makes it difficult to draft a clear position -in terms of contracting trends- for the Netherlands.

From the four main trends in procurement, the Spanish model can be characterized by its experience in private financing, first with direct tolls and recently with shadow tolls- and very long term contracts. Spain could already build on experience developed since the 1970s. The use of contracts that integrate design with construction do not seem to be a priority. This is probably due to the bad experience they had in the 1990s when a DB scheme, with payment in unitary prices and not lump-sum had been implemented. Nevertheless Spanish seem pioneers in integrating safety related tasks into their integrated maintenance contracts. The Finnish procurement model is, in turn, specific in its great advance in the use of integrated contracts-with 60 per cent of projects tendered as DB-and their experience in the use of performance based contracts for routine maintenance.

The use of quality related criteria for the selection of contractors is more advanced in Spain than in Finland. This is partly due to certain informal institutions to be discussed in the sub-section below. Both countries implemented integrated maintenance contracts around the same period, in 1998. The difference is that while Finland first had to realize a restructuring of the road agency and create a completely new market, Spain was already outsourcing a greater part of it and only had to reorganize the tendering of these tasks.

Periodic maintenance has remained rather traditional in all three countries. In Finland and the Netherlands contractor selection remains totally based on price and in all of them contracts are prescriptive, detailed and very short-term. Consequently there are plans to make important reforms in this sector, either by combining periodic with routine maintenance in one contract or by developing long term rehabilitation contracts for a whole road network.

As explained previously, in all countries these new contracting practices have caused a shift in governance from a public bureau to a market-like arrangement. These practices have also resulted in innovative arrangements for ex-post management of contracts. A common method used is the so called "own responsibility principle". Contractors have to submit, alongside their offers, a quality control plan and regularly prepare reports for the road authority. Consultants are then hired to check if contractors are following plans and procedures as promised. If not, penalties will follow.

In Finland one of the main concerns expressed was the lack of trust between the various players preventing the creation of long-term alliances. This is surprising in light of the substantial attention paid by Finnra to transparency, open competition and ef-

ficiency. There is no guarantee for a contractor to win a maintenance contract in the next term, only because it won the previous one. Its offer has to be objectively better to win the new round, so the time-horizon is rather short. Finnra actively promotes the participation of international companies in Finnish projects, which objective was successful when in 2006 two routine contracts were won by an Estonian company.

The situation in Spain is characterized by more frequent informal contacts between road authorities and contractors. They seem less cautious about a regular information-exchange, even during tenders. This is partly because transparency is not as highly valued as in Finland. Contractors in Spain accept more easily than in Finland that the selection of the winner is not completely objective. Many other selection criteria than price are used, without use of detailed guidelines as to how quality points are assigned. Moreover the success of Spanish companies in the national and international markets is deemed very important in Spain, more so than efficiency or the existence of a solid competitive market. This attitude reinforces the already existing principle of non-intervention among contractors, for instance in a quota system for distribution of the sales of raw materials.

The ex-post management and monitoring of contracts in Spain is also very different than in Finland or the Netherlands. The relationship between road agency and contractor is much richer than merely a written contract. The contract is not the last word, but rather the beginning of a continuous process of negotiation. As a result, there can be a great gap between the contract signed and the practice. An example is provided in an interview with the Operations Director of Maintenance Concessionaire in Spain (20 June 2007):

> In the contract between the Public Concessionaire (Bidegi) and the special purpose company (Bidelán) signed in 2003, there were certain levels of service and values for performance indicators agreed. These however have not been monitored the first four years. This is the result of a later agreement between the contracting parties, where it was recognized that the condition in which the existing roads where delivered was also different than provided in the contract, and, therefore those levels of service required were impossible to achieve.

This gap between written documents and practice has also an effect on the design freedom experienced by contractors. By only reading the tendering documents of the different countries it would be impossible to judge the real design freedom they give to contractors. As a representative from a large international concessionaire explained, the difference is mainly in the attitude of national authorities and their openness to discuss changes in the design they propose. Spanish authorities seem to be more flexible and ready in accepting design modifications than their North European colleagues.

In terms of informal institutions and ex-post management of contracts, the Dutch situation resembles the Finnish one although somewhat nuanced. Both countries pay

substantial attention to open competition and efficiency and limit the relationship with contractors to the written contract, though in the Netherlands the contract requirements are applied to some extent less strict than in Finland. Therefore both have a tendency to aim at "complete" contracts that foresee all contingencies. As mentioned before, this last aspect is experienced as an obstacle for the implementation of long term contracts, for which is nearly impossible to anticipate all possible events.

Another common element between these two North European countries is the search for open competition and efficiency; which is also observed in the attitude of citizens and national market players toward foreign ones. Dutch companies often see international players not as a threat but rather as potential strategic partners to win large complex projects for which they may not have in house all the needed expertise. Given the size and the geographical position of the Dutch market, this could be considered even more open to international competitors than the Finnish one.

5.6 The national paths and reform processes

Not all the measures presented in the worldwide reform agenda can be applied at the same time, at least not with equal focus. Some of them could be even contradictory. In the three national models described above, it appears that countries pick different objectives and measures from this global pool, depending on the priorities their national actors have. Once such a selection is made and the reform process set in motion, it proves that some ideas are hard to combine or even exclude each other, making the course chosen hard to bend. In this sub-section, it will be reviewed how the Finnish, the Spanish and the Dutch paths developed. The main elements of their national agendas, the consequent objectives that were chosen, and the path-dependent process that evolved, will be examined.

5.6.1 The Finnish path

Traditionally Finland was not an open market economy. In the 1960s the government had a firm grasp on many economic sectors including the financial sector. For instance, all banks were government owned. A series of events in the early 1990s caused a change in the public management of infrastructures, from the welfare state towards a market-orientation state (Salminen and Viinamäki 2001). The main events were the economic recession of 1992, the collapse of the banking system and the collapse of the Soviet Union, Finland's largest trade partner. These events demanded a radical and urgent response from the Finnish government and created a window of opportunity for the new public management paradigm (De Jong and Äijö 2001).

Already since the beginning of the 1990s, Finnra's top management promoted the reform, and, in 1996, a proposal was presented to Parliament. Parliament rejected it but this setback did not stop the initiators of the reform. They kept discussing

possible reform with several stakeholders (Ojala and Sirvio 1998). The years 1998-2001 were a period of intensive preparation to safeguard a smooth transition, after the new legislation would be approved. When Parliament did approve it in 2001, the FRE was officially born.

Although various options were considered by the Finnish government, "full privatization" was not among them (Ojala and Sirvio 1998, 3). The government preferred an SOE, allowing for substantial state control. Finnra's top management was also more concerned about achieving formal unbundling of agency and enterprise.

Once new legislation was in place and the FRE officially born, it was time to liberalize the sector and open the market to new players. Working groups were created in which a transition plan was discussed with which most stakeholders could concur. This transition process leading to an open market lasted two years for design and construction and four years for periodic and routine maintenance. This gradual opening meant the gradual phasing out of negotiated contracts between Finnra and FRE, and an increase in the number of contracts decided by competitive tendering. Full competition is in place in the sector since 2004.

The path followed by Finland coincides with the seven phase-model proposed by the World Bank, with the only difference that a road fund has not been created. The situation in 1996 can be compared with phase 1. Then, between 1998 and 2001, promoted by strong leadership within Finnra, phases 2 and 3 were carried out. The necessary steps to move on to phase 4 were taken by gradually opening the market and FRE now operates in a fully competitive market. There are plans to open the enterprise to private investors; but not decision on this matter has been taken yet. There are no discussions about bringing the reform further than phase 5.

5.6.2 The Spanish path

Compared to other European countries, Spain has had a democratic regime only since 1975 and is a member of the European Union since 1986. Ever since Spain's governments have made serious attempts to stabilize and strengthen their economy. And yet, when the Partido Popular (PP) gained office in 1996, they inherited an economy with serious problems that along with plans to join the European Monetary Union, set the stage for a reform of the public sector.

The dominant road procurement model Spain had used until 1996 was traditional. Infrastructure construction and maintenance were completely financed with public funds. Only in exceptional cases did legislation allow government roads to be given in concession to private entities. It should be mentioned that the old system of toll highways, which had been introduced in 1965, was stopped in 1982 by the then socialist government.

The situation in 1996 made a revision of their infrastructure delivery model urgent. Key factors responsible for this sense of urgency were a serious infrastructure deficit in comparison with the most advanced members of the European Union and

tough requirements to control public spending. The new government focused on the liberalization of the economy and the privatization of many national companies.

The road reform being proposed basically consisted in going from the traditional direct financing of infrastructures to private financing. It consists of returning to the old concession model, where infrastructure projects are financed by direct contributions from users through toll. And since the projects planned concerned roads with probably much less traffic than the ones given in concessions in the 1960s, it was proposed to lengthen the maximum concession period to 75 years, for existing concessions and for new projects. Other project delivery methods being considered were DB or llave en mano (turn-key) that would defer the payment of the infrastructure to the delivery moment.

The government, aiming at involving the private sector in the delivery of infrastructures, implemented a series of fiscal, administrative and social measures that set the legal basis of the new infrastructure delivery model. These were adopted throughout the Aznar administration from 1996 to 2000. They implied important changes in the legal framework and particularly in the Highway Concessions Law, which had been left outdated since the concession regime was stopped in 1982. Even though the new infrastructure delivery model had the old concession model as a basis, its wider reimplementation required a new legal framework and equally importantly, a pool of projects, mature enough to be given in concession.

Some of the measures adopted were the incorporation of lump sum contracts within the General Contract Law for Public Works (art. 147, L13/96) and the creation of the legal figure "contracting for integrated maintenance services" (art. 60, L55/99); the modification of the Law on Highway Concessions making it possible to use the concessionaire figure for complementary activities, to extend the concession period to a maximum of 75 years and to extend the concession to neighbouring road sections (art.157, L13/96), all with the goal to make projects more profitable and attractive to private investors; the extension of the concessionaire as a legal figure to cover also maintenance and exploitation of already existing road sections (art.59, L55/99); and opening the possibility to create a state company or public concessionaire able to acquire debts (art.158, L13/96) (Izquierdo and Vasallo 2004).

In 1996 the size of the public sector in general and road authority in particular was already moderate. This was partly due to the 1982 Autonomy Statute that already transferred many tasks and staff to the autonomous communities, and partly to the first stream of privatizations carried out by socialist government from 1982 to 1996. Levels of outsourcing were also comparable to Finland and even higher for routine maintenance. As mentioned before, there was an old tradition of toll roads and concessions since the 1960s when the first highways, like the Barcelona-La Junquera, and Bilbao-Behobia, were given in concession. There was a pool of contractors, therefore, experienced in this model. The different stakeholders unanimously agreed that the main drivers for the reform and implementation of many innovative contracting practices was the need to reduce the public debt and the need for further expansion of

the network.

5.6.3 The Dutch path

As mentioned in previous sections, the Dutch reform path is not as clear-cut as the paths followed by Spain or Finland. Therefore the description of the Dutch case may require a somewhat more comprehensive approach. Besides, two parallel reform processes will be explained. First, the introduction of PPP contracts within the different ministries; second, the reforms directly concerning national road authorities (i.e. MinVenW and RWS).

The Netherlands is one of the founding members of the European Union. As founding member the Netherlands have played an important part in promoting EU integration and pioneering closer European ties. The Dutch economy, strongly geared to exports, has benefited hugely from EU membership. In other words, the Netherlands has been an open market economy with a significantly more international orientation earlier than Finland and Spain. By the early eighties the Dutch welfare state had developed to the most extensive social security system in the world. Nevertheless this welfare state experienced a crisis around the same time when unemployment reached levels over 11% and the budget deficit rose to 10.7% of the National Income. In reaction the centre-right and centre-left coalitions of CDA-VVD and CDA-PvdA -cabinets Lubers I, II and III from 1982 till 1994- reformed the welfare state. Social benefits were reduced, taxes lowered and businesses deregulated. Progressively the economy improved and the budget deficit and unemployment were reduced significantly[6].

As in Finland, the first signs of a new kind of public managed paradigm - the so called New Public Management- started to appear in the late eighties, early nineties. The difference is that since no strong financial crisis was being faced -as in Finland- no radical changes were implemented then and the government did not reduce significantly its size. Some institutions may have become smaller but the Ministry of Transport, Public Works and Water Management (VenW) and RWS actually have kept growing.

The Purple cabinets Kok I and Kok II from 1994 till 2002, were a coalition formed between PvdA, D66 (a progressive liberal party) and VVD. For the first time in eighty years a coalition was formed without the Christian-democrats (CDA). During first purple cabinet (1994-1998) the policy relating to government finances already introduced by the previous "third cabinet Lubbers" was continued. The Netherlands was partly forced to do so be able to fulfil the requirements for participation in the European Monetary Union. All in all the Purple coalition marked a period of substantial economic growth. In fact during most of Kok's time as Prime Minister, the Netherlands was booming economically and he was credited internationally for the Dutch "Polder

[6]Source: `http://en.wikipedia.org/wiki/Politics_of_the_Netherlands`

Model"[7].

Early 2002 the same "polder model" came under fierce attack particularly from politicians like Pim Fortuyn, a right-wing populist political new comer. The effects of this criticism were felt at the following election in 2002 where the coalition lost their majority. A new cabinet was formed by the CDA, VVD and the newly created LPF (the party founded by Pim Fortuyn), led by Prime Minister Jan Peter Balkenende. This coalition felt apart and in January 2003 new elections took place. The centre-right cabinet Balkenende II was then formed by the CDA, the VVD and the progressive liberal party D66. This coalition started an ambitious program of welfare state reforms, health care privatization and stricter immigration policies. A new cabinet Balkenende III started in 2006 as the D66 withdrew its support for the coalition.

Advance in the use of PPP contracts

The first changes in public procurement practices were initiated in 1995. During the purple cabinets lead by Prime Minister Kok a policy that aimed at creating more room for the market was brought forward. In this context public private partnerships were considered an instrument with great potential to materialize this policy goal. To advance in this direction a policy document was drafted in 1998 called "More value through cooperation". The conclusions of this policy document were adopted by the second purple cabinet and formed the basis of the PPP national governmental policy. In this context a group of projects were chosen and categorized as "low-hanging fruits[8]"; to bring PPP into practice. Most of these projects selected in 1998 as easy targets, had four years later not yet been realized (Klijn and Teisman 2002)).

This was however not the first time that PPP contracting schemes were considered in the Netherlands. This was actually the second PPP wave. The first wave dates from the second half of the eighties. In that time different projects were realized that could be more or less considered PPP projects. The two most important ones were the "Noordtunnel" and the "Wijkertunnel; both tunnels delivered under a kind of

[7]The polder model is a term with uncertain origin that was first used to describe the internationally acclaimed Dutch version of consensus policy in economics, specifically in the 1980s and 1990s. However, the term was quickly adopted for a much wider meaning, for similar cases of consensus decision-making, which are supposedly typically Dutch. It is described with phrases like "a pragmatic recognition of pluriformity" and "cooperation despite differences". This model is also used in Belgium, hence its name (the "Polders" are a region comprising most of the Netherlands and the North-Western part of Belgium). A popular explanation of both the term and the reason this decision-making style works so well in the Netherlands is the unique situation created by the fact that a large part of the country consists of polders below sea-level. Ever since the Middle Ages, competing or even warring cities in the same polder were forced to set aside their differences to maintain the polders, lest they both be flooded. Another explanation points to the dependency of the Netherlands on the international economy. The Dutch cannot afford protectionism against the unpredictable tides of the international economy, because it is not an autarkic economy. Therefore to cushion against the international economy, the Dutch set up a tri-partite council which oversaw an extensive welfare state. (Source: `http://en.wikipedia.org/wiki/Polder_Model`)

[8]Low-hanging fruits are targets or goals which are easily achievable and which do not require a lot of effort.

DBFM contract and financed through shadow tolls. The critical comments[9] presented in the reports of both two tunnel projects -by instances like the national audit office[10]- reduced significantly the enthusiasm about PPP and the idea disappeared from the political agenda for a number of years.

The second PPP wave is characterized by an emphasis on contracts. In order to back up the PPP policy of the cabinet Kok II and to join all knowledge, expertise and experience available, the PPP Knowledge Centre[11] was created. This was placed under the responsibility of the Ministry of Finances. The mission of the centre was to make PPP (or DBFM) an accepted procurement or project delivery method in the different ministries. Though many resources were invested in the promotion of PPP and on the development of the needed instruments for a proper implementation of these new contracts; the practical advance in the use of PPP schemes for the delivery of large infrastructure projects remains limited.

Finally it is important to highlight that the policy discussions about PPP at the national level were strongly influenced by the experiences and the discussions in England about the so called Private Finance Initiative (PFI) and therefore one could talk about "policy transfer" (Klijn and Teisman 2000; 2002). A more recent event that has placed again the issue of PPP in the political arena are the findings of the Ruding parliament commission[12], presented in June of 2008.

The reform of the road sector: RWS becomes an agency

In parallel to the developments in the area of PPP projects, a discussion about the reform of RWS started to take place already in the early years of this decade. The Ministry of Finance started since the early nineties to promote the restructuring of government institutions. These changes were realized under the assumption that an autonomous institution or government agency -placed at a distance or made independent- would function better than if working as a department under a ministry. Apart from privatization, the first option considered for granting autonomy for public entities was the establishment of autonomous administrative authorities or "zelfstandig bestuursorgaan" (ZBO) in Dutch. Later in the nineties a new course was chosen as politicians started to have doubts about the accountability of ZBO's. From then on the

[9]The essence of the problem was probably a miscalculation of future traffic levels that lead to profit levels of consortium considered as too high by the public opinion.

[10]Algemene Rekenkamer in Dutch

[11]Kenniscentrum PPS in Dutch

[12]The commission concluded that large cost savings -of at least 10%- and earlier project delivery could be achieved through the use of DBFM contracting schemes. The main recommendations of this commission were: a) to increase deal flow, b) change in the government culture -get rid of natural resistance- ; c) create more possibilities for provincial and municipal governments; d) involve more and more institutional investors in the construction of infrastructures and e)explore the possibilities of private payments or direct tolls. Source: Aanleg infrastructuur beter en goedkoper met PPS. Corien Wortman-Kool, Lid van het Europees Parlement and Lid van de Commissie Ruding. NIB Conferentie PPS in Bouw en Infra, 20 November 2008.

agency model -that emphasizes on internal autonomy- gained more popularity within the government (Soltani 2008). In this variant, the governing board of the public entity (agency) commits to attain an agreed performance level, within an established budget. Since 1994 till the present about 40 government services were given more independence by converting them in agencies.

This process was slowly starting also within the VenW, which by 2003 started to prepare for the implementation of innovative contracting practices, starting with the development of standard procedures; presented in more detail in Chapter 4. RWS presented its first corporate procurement strategy in 2004 characterized by the slogan "the market unless". Later on in January 2006 RWS became officially an agency. It was in fact the last organization within the Ministry to gain autonomy. In the last two decennia about 25 entities had been either privatized, or had become autonomous administrative authority (zelfstandig bestuursorgaan -ZBO) or departmental agencies.

The central thought behind this change as expressed by the MinVenW in the corporate business plan of 2004 was laying down "A new perspective for Rijkswaterstaat". In this plan RWS is described in its present organizational form as follows; an organization that does not work purposely or efficiently enough, is not concerned or aware of costs and lacks and economic or business orientation. Up to that moment RWS had a strong engineering orientation and a well known reputation in Europe due to its specialized technical expertise.

A decisive event for both developmental paths presented above, was the major scandal involving fraud in the Dutch construction industry in 2001 and the findings of the subsequent Parliament Committee Inquiry into Construction Fraud[13] (2002-2003). Though this scandal could have also stopped the reform process -towards the use of more and more integrated contracts and private financing- it actually accelerated or boosted these two undergoing processes and set the stage for more operational choices. In other words, it was the trigger for the reform. It brought the topic to the public attention, creating a sense of urgency that forced politicians to take a step forward to restructure the sector.

This event not only created a window of opportunity for the reform, but it somehow also changed it emphasis. Up to that moment the reform of RWS was mainly aiming at a staff reduction -lead by the slogan "more work with less people"- and after the fraud scandal a new goal gained priority. The internal reorganization of RWS as well as the new contracting practices been promoted in the first corporate business plan and procurement strategy (2004-2008) should contribute to break the old system of agreements between contractors and promote a renovation of the sector; expressed under the slogan "the market unless".

Recently a new change is recorded in the leading slogan of RWS procurement policy. Some experts believe that since 5 November 2008 the slogan of RWS "the market unless" has became "PPP unless".

[13]Parlementaire enquête bouwnijverheid (2002-2003) in Dutch.

5.7 The different national models in a nutshell

The reform process has followed different paths in the countries studied. Though in all of them the goal was to move towards what according to New Public Management is a more efficient way of organizing procurement of public infrastructures; the specific drivers as well as the specific practices that have been implemented are different.

In Finland the main goal of the road reform is the selection of a more commercial approach to road management (see Figure 5.4). This results from a combination of external factors (mainly the process integration to the EU and the fiscal discipline it required), initial conditions (an oversized road authority) and historical and cultural circumstances generating particular preferences among different actors (like the lack of experience in private financing). This first selection conveys a particular focus on efficiency and reducing the size of the road agency. Consequently from the list of second level goals, Finland has chosen primarily to right-size the personnel structure of road authorities and better staff incentives in the second place. Both goals predictably lead to a radical restructuring of the road agency through unbundling production from regulation.

Spain chose the road reform to ensure adequate and stable supply of funds to the road sector (see Figure 5.5). It has a different national agenda marked by the need to reduce the public deficit from 5.7 per cent to 2.7 per cent in less than a year, an evident backlog in infrastructure and recent experience in the use of private financing. The most logical policy instrument to achieve this goal was to encourage the introduction of the user pays principle, which in Spanish terms meant a return to the old concession model. Since Spain did not have a significant production portion in-house or problems of an over-sized road authority, efficiency was not a key driver, and restructuring the existing road authority was not considered necessary.

The choices of these countries have also had an important impact on the contracting practices they have developed. Spain has become a pioneer in private financing schemes and longer term contracts, allowing them to expand their transport network without increasing the financial deficit. Finland has become a pioneer in integrated and performance-based contracts reducing the agency staff needed to keep contractors under control. In financing delivery methods, Finland has experience only with pre-financing methods, as they do not require the introduction of the user pays principle. Broadly speaking, one could say that Spain mainly went through a privatization process, while Finland focused on the liberalization aspects of road reform.

Spain's most recent changes in procurement practices reflect an interesting example of path dependency. In 2004 the socialists gained power again, and, as could be expected in light of their position before the reform in 1996, they have tried to turn back the clock. However it was not possible for them to go back to the model of direct financing of infrastructure projects prevalent before the reform. At the national level, they have introduced a system of shadow toll concessions instead of direct toll. This essentially

Figure 5.4: *The Finnish reform path*

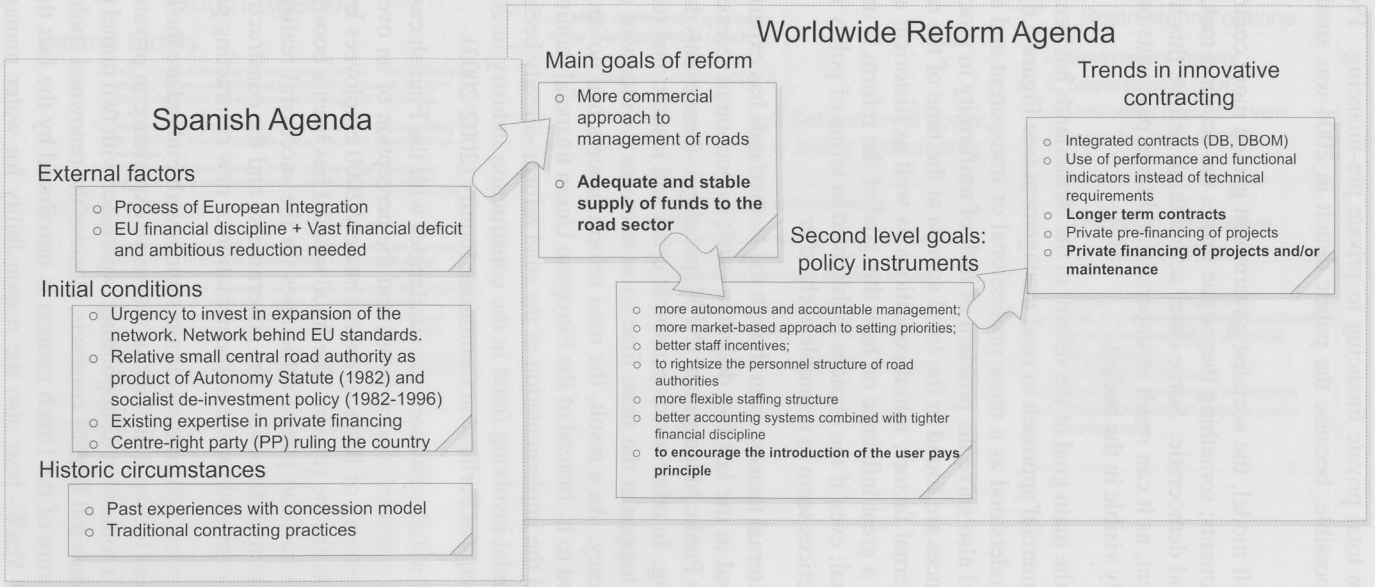

Figure 5.5: *The Spanish reform path*

implies a shift from total private financing to private pre-financing. Probably this change was made possible, because the public deficit in 2004 was smaller than in 1996.

With the shadow toll model, the socialist government gained more control over the infrastructure investments; something they argue makes the decision-making process more transparent and democratic. Some other actors think believe this model is actually less transparent, as it can result in uncertain and large payments in the future, which are not readily visible in the budget.

Similar to Finland, the main goal of the reform in the Netherlands has been the selection of a more commercial approach to road management (see Figure 5.6), nevertheless in some way understood as a more professional or transparent and accountable approach that would also solve the problem of lack of uniformity in procuring practices. Great differences are found in the local agenda at the time of the reform. The constellation of external factors, initial conditions as well as historical and cultural circumstances have a great influence on how this goal of the reform is implemented and made operational; even if the choices highlighted in terms of policy instruments and contracting practices seem to resemble each other.

First, in terms of external factors; even though the Netherlands has experienced similar events as Finland in the last two decennia -such as economic recession and the introduction of New Public Management (NPM) paradigm -these events did not occur with the same timing. In other words economic crisis and institutional reform of the road sector did not happen at the same time so as to create a window of opportunity and a sense of urgency. As a result, the road reform process had no single hard financial goal attached to it. Instead of the European Union financial requirements, the events that hastened the implementation of the road reform -already been discussed- were the major scandal involving fraud in the construction industry in 2001 and the findings of the subsequent Parliament Committee Inquiry (2002-2003).

Second, in terms of initial conditions the similarities with the Finnish case are a relatively modern and extended road network and the perception of an oversized road authority. The downsizing of RWS in approximately 2000 employees by 2008 was the only hard goal set for the reform. The fraud scandal has been a boosting element for the reform but it has also placed difficulties for the successful realization of the reform. The distrust created between the governmenet and the construction industry is not the most fertile ground for the implementation of new contracting practices.

Third, common historical and cultural circumstances with Finland are the low societal support towards direct tolls and the lack of extensive experience in private financing. The Dutch had only a somewhat disappointing experience with two tunnel projects delivered through shadow toll DBFM contracts. Besides the renowned "polder model", another peculiar feature of the Dutch context is introduced by the fact that road authorities -RWS and VenW- bear also the responsibility for water management and

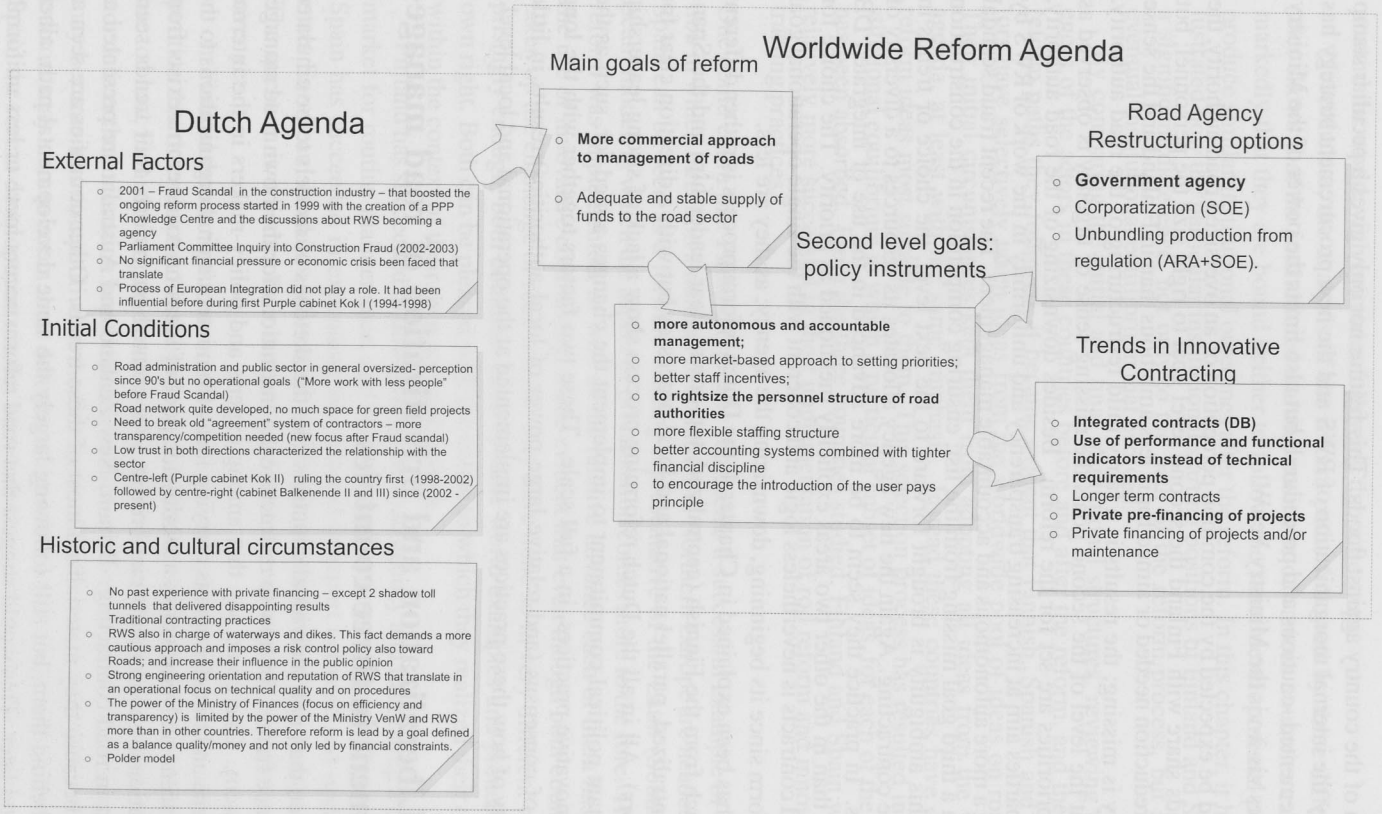

Figure 5.6: *The Dutch reform path*

protection of the country against floods. This feature not only gives a peculiar stamp on the way the internal reorganization of RWS and the new procurement strategy has been implemented -cautious and procedural- but also limits the power of the Ministry of Finances vis-à-vis the Ministry VenW.

As it could be expected by the common perception of an oversized road authority, the Netherlands share with Finland the second level goal to right size the personnel; but since the reduction needed or aimed for is less ambitious than in Finland and the sense of urgency is missing; the results is a fairly mild restructuring of the road authority. Already at the level of the second goals the missing sense of urgency is observed as no clear priorities are set for the reform. Besides downsizing of the road authority, political parties aim at increasing transparency and uniformity in the work of RWS by achieving a more autonomous and accountable management. The recent fraud scandal adds even a third goal missing from the list; ensuring competition in the construction sector. This ambiguity is brought forward to the next level, the choice or trends in innovative contracting. Again the new agency allocates its resources to a diversity of objectives. In practice they seem to be more advanced in the use of integrated DB contracts than in the other two areas explicitly mentioned as priority. The choice for integrated contracts is nevertheless logic and coherent with the single operational goal of the reform since its beginning, downsizing the agency; as they are less.

As it has been explained in Chapter 4, the Dutch reform process is rather different in approach from the Finnish (centralized, top-down, clear leadership) and the Spanish (decentralized, parallel national and local processes but with a direction clear for contractors). All in all the Dutch reforming process show a lack of strong leadership and constant political commitment to implement the changes aimed for, such as the use of innovative practices, in a full scale. These two factors together with the long tradition of consensus (and relative large power of local authorities) results in little uniformity of how these practices are implemented at the operational and local level.

5.8 Liberalization and privatization of road management in three countries

More often than not, individual countries take the sketches of models to be emulated as reference frames for how to restructure the institutions for their own road management system. One could say that among experts and policy-makers in the international arena and transfer agents carrying ideas from international organizations to the national scene and vice versa, a worldwide pool of ideas on road reform exists from which national governments can borrow. As pointed out before, four trends seem dominant in road contracting. Britain, New Zealand and Australia are presented as leading, because they materialized most of these trends. Other countries are seen as lagging behind them, but still following largely the same developmental path, albeit slower and later. This would suggest that road reform occurs more or less uniformly

around the world, with countries following the same steps.

Nevertheless, the analysis of the reform paths followed by three different countries shows that the institutional starting positions of various countries can differ so markedly that they are bound neither to follow the same developmental paths nor to produce similar institutional outcomes after the reform. In this chapter, it has been illustrated how the particular institutional starting positions of Finland and Spain made a significant difference, not only to the path of the reform process, but also to the eventual institutional equilibrium that evolved.

By comparing the initial and final institutional structures, reviewing the preferences of the actors in these countries before and after the reform, and the particular reform paths they followed, it became evident that Finnish, Spanish and Dutch actors have selectively taken ideas from the worldwide pool of ideas on road reform. Their initial circumstances kept them from adopting all ideas from the worldwide agenda, at least with the same emphasis. Instead these countries have chosen the reform ideas most suitable to them. This selection process has resulted in a new institutional equilibrium in which a particular subset of ideas, for each of the countries, has been absorbed. From the three countries studied, Finland and Spain were found relatively more successful in their implementation of rod reform and innovative contracting practices.

One could claim that Finland typically represents a successful example of liberalization in which direction a number of countries in Northern Europe are headed, whereas Spain can be seen as a forward-looking representative of the Latin (Southern European) model, in which the aspect of privatization comes more to the fore. The way the reform was implemented, as well as the relative advance each of them has shown in the use of innovative contracting, made evident that even though both countries have taken up the challenge of road reform, they have done so in very different ways. Surprisingly enough, both countries have become world examples and pioneers in their own right. Both can be pleased with the extent to which they realized their objectives, within the context of their own national system.

Finland has succeeded in downsizing the road agency and in creating a brand-new market for routine maintenance, and has achieved savings of up to 40 per cent. And Spain has succeeded in expanding the national transport network and updating it to meet European standards, all within the financial strictures of the European Union. The question is whether their current equilibria are sustainable. Challenges are not over yet.

In Finland the strong focus on efficiency and competition is causing cutthroat competition that threatens to affect negatively the development of the sector. If profit levels are too low, Finnish companies will not be able to invest in research and development, nor deliver the innovation hoped for in these innovative contracts. In the long run, they may become less competitive in the European and other international markets. Contractors may start to act in their defence and push towards a new wave of reforms. In Spain the recent developments in the use of shadow-tolls for the financing of projects

is expected to create serious financial problems in the future, which may necessitate a new wave of reforms. In both cases, the current institutional equilibria may still turn out to have been sub-optimal and temporary ones.

In addition, the analysis shows that it does not matter as much for the success of the reform which particular choices are made or which specific drivers are behind the reform; as long as the choices taken are coherent with each other and the reform follows a clear implementation process for all stakeholders -more importantly contractors and financial entities. More than the goals behind the reform it is important how the process as a whole is managed by the leading authorities.

The Dutch reform lacks a clear driver and a sense or urgency. Consequently results are difficult to judge, ranging from poor to ambiguous. The needed skills and expertise for a successful implementation of innovative contracts do not seem to be yet in place -neither in the public nor the private sector-, market players do not seem satisfied and the contracting practices of RWS still lack uniformity. The only clear result is the reduction of the agency personnel, in fact the only operational goal set since the beginnings of the reform.

Therefore the Netherlands does have lessons to learn from pioneers as Spain and Finland. Inspiration can be found in the Spanish case on how they have succeeded on creating enough deal flow for PPP projects that offset the high transaction costs involved. Meanwhile Finland is a good example on strong (internal) agency leadership, on the management of stakeholders so to achieve consensus up-front[14] and on keeping the implementation plan discussed with stakeholders fixed for a significant number of years even though external pressures. The consistency and resolution showed by Finnra gained the trust and eventually the support of contractors and consultants, even if they at first opposed the reform proposed. The question is till what extent the implementation of these lessons requires a completely new way of decision making or policy making styles in the Netherlands and even reforms to the current regulations.

All in all it means that even though the differences in institutional contexts and historical developments, learning from another country it is possible. What remains unattainable is the formulation of ready-make recipes or best practices, applicable to a wide range of countries, independent of their goals or priorities.

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[14]Consensus was built through a number of seminars where all stakeholders could make their opinions public about the proposed reform plan. Once few changes where implemented, the implementation plan did change. The Netherlands instead is aiming continuously at achieving consensus.

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Chapter 6

Road Roles: development and implementation of a gaming-simulation

Parts of this chapter have already been published in: Altamirano et al. (2007; 2008), Altamirano and de Jong (2009).

6.1 Introduction

As explained in previous chapters, the increasing use of innovative contracting practices has meant a shift from the traditional setting were private parties and market occupied only the position of a "hired hand" (Salminen and Viinamäki 2001) to a new situation where contractors have become service providers. These new practices are expected to contribute to innovation, efficiency gains and consequently lower costs while keeping equal levels of service.

As explained in Chapter 3, given that as their use appears to be becoming more widespread, it is not only the design space of contractors and therefore opportunities for innovation and gains in efficiency, but also the phenomenon of information asymmetry, which may play a role - the contractor holds more private information that is not available to the road authority. Greater scope for opportunistic behaviour makes research into how contractors will react to this freedom all the more urgent. If opportunistic behaviour does take place, how far-reaching are the consequences of this behaviour for the performance of the road system? In order to investigate these and other questions, a gaming- simulation called Road Roles has been developed.

Limited application and scant historical information gathered up to recent years, do not allow reaching consensus about the effects of these practices in terms of sys-

tem performance and economic efficiency following traditional research techniques like statistical data analysis. Therefore it seems important to find new ways. Methods like gaming-simulation, that allow the investigation of future scenarios and the discussion about possible implications for the condition of the road network, the economic performance of the system, the development of the private sector and the safeguarding of public values; in a more structured way.

This chapter presents Road Roles, the gaming-simulation developed to investigate medium and long-term effects of innovative contracting practices, and the impact of different incentive schemes on promoting cooperative or defecting contractors' behaviour. It explains how the gaming-simulation developed, Road Roles, can contribute to our understanding of the consequences of new contracting practices, how the game was set up, and what the results were in the 14 different runs that were held in the Netherlands, Finland and Spain. The three most characteristic and colourful game-runs have been highlighted and described in more elaboration.

6.2 State of the art theory on tendering

Extensive research has been conducted on tendering, pricing mechanisms and bidding strategies. Interesting studies can be found in the literature of tendering theory (Friedman 1956, Park and Chapin Jr. 1992) and auction theory (Cox et al. 1988, Milgrom and Weber 1989). A recent example is provided by the work of Dyer and Kagel (1996), who organised a series of experiments on auction behaviour. These theories are based on different assumptions in the way they allow for counter-strategies, continuity of time and the adjustment of prices to demand and supply.

Though tendering is at the centre of this study, its focus is different to previous work in that it does not attempt to find the best bidding strategy, but to understand opportunistic behaviour in new contracting practices and its wider consequences for the functioning of the system. This means that it does not end with the assignment of a tender, but continues to research the whole contracting process. Consequently, the resulting model -Road Roles- incorporates at least three new elements:

- Additional selection criteria - at the discretion of the road authority.
- Contractual requirements and post-tender economic incentives, which, along with the fact that it is a network and not a single road which is being contracted out, allow contractors greater freedom in their work plans and therefore variation in contractors' production costs.
- Market conditions are recreated, as suggested by Runeson and Skitmore (1999) - given that time is continuous and "best strategies" depend not only on the number of competitors, but also on their financial strength, on the tendering rules (selection criteria and requirements) which are influenced by the principal's budget, and on the condition of the network.

Since the winning strategy in Road Roles depends partly on the strategy followed by other competitors, and there is also room for continuity (the outcome of one tender process is affected by the outcome of previous events and also affects subsequent tender processes), this gaming exercise has more similarities with experimental methods rooted in game theory than with tendering or auction theory as specific branches.

6.3 Methodological positioning of Road Roles

Game theory is the science of strategy. It attempts to determine mathematically and logically the actions that players should take to secure the best outcomes for themselves in a wide range of games (Dixit and Nalebuff 2008). Gaming-simulation can be considered a hybrid form of two sets of decision techniques: formal mathematic models and "judgemental" techniques. Duke and Geurts (2004) state that the optimal approach to strategic planning formulation "should try to combine the best of these two approaches". In gaming-simulation, reality is simulated through the interaction of role players who use non-formal symbols with formal, computerised sub-models. Road Roles can be characterised as combining elements of both these two streams.

This section will not describe in detail the differences and similarities of this experiment with the experiments proposed by gaming-simulation (Geurts et al. 2000), game theory (Kreps 1990) and behavioural (experimental) economics (Fehr et al. 2002), but it is important to state that the game exercise proposed - developed according to gaming-simulation guidelines - has a strong game-theoretic component. Consequently, the design and resulting observations are comparable to some experiments conducted by experimental economists, except that it allows players greater freedom of decision. Similar elements, such as monetary pay-offs, principal's choices to apply sanctions or give rewards and the possibility of applying the concept of total sum - or total performance of exercise - are used. The main difference is that players are allowed greater freedom. Rewards and sanctions are not fixed within a range, but are set at the discretion of the road authority. Agents are not judged in terms of their efforts but the results (road condition) they deliver, meaning that an additional risk element is present. Both these differences were introduced because of the central research question - innovative contracts and how to limit opportunistic behaviour. They produce findings more directly relevant to the specific contracts being studied and ready to be applied to procurement policy.

6.4 Design and development of Road Roles

The process of designing a gaming-simulation or policy exercise, basically consists of "deriving a theory of real-world behaviour, construction of a model to reflect this theory, and translating this model into a game" (Duke and Geurts 2004). Having as a basis the understanding of national procurement systems built through the first system

analysis presented in Chapter 3, a game has been developed called Road Roles. The following sub sections will give insight in the process of its design it, the resulting prototype and its testing.

A choice has been made to focus the policy exercise on the area of periodic maintenance[1]. Chapter 4 pointed out that on the one hand, the relative advance in the use of these innovative practices in the market of capital projects is large in countries like Finland, Spain and the Netherlands and also significant in the area of routine maintenance in countries like Finland and Spain. Meanwhile, the market and the contracts used in periodic maintenance remain rather traditional. If one also considers the quantitative magnitude of periodic maintenance contracts versus the few new capital projects and the relatively large influence they have on the condition of the network versus more surface related activities like the ones included in routine maintenance; the choice for researching the impact of innovative contracts -that give more design freedom to contractors- precisely in this area of periodic maintenance, seems by far the most significant. It is precisely in this area that revolutionary changes are expected in the future.

The design process will be presented as proposed by Wenzler (1996). He proposes five steps: 1) development of design specifications; 2) system analysis of the problem being addressed; 3) transformation of the conceptual model into a gaming model; 4) development of the prototype; and 5) development and implementation of the final product. They coincide with the five phases proposed by (Duke and Geurts 2004) in Chapter 8, titled Designing the Policy Exercise, of their book "Policy Games for Strategic Management". The following subsections present steps one to four. The resulting gaming-simulation or prototype is presented in Section 6.5, and two aspects included in the final phase of implementation -game evaluation and field use of the game- will be presented in Section 6.6.

6.4.1 Step 1: Development of design specifications

As stated by Duke (1980) in his article "A paradigm for Game Design", before game construction actually begins, it is necessary to determine the game's purpose - the messages to be communicated and the means of conveying it. This section will present the specific set of requirements, which describe the expectations, and limitations of the game.

[1]The public obligation of providing a transportation network can be divided in four different kinds of tasks: (1) capital projects, the construction of green field projects or new roads; (2) routine maintenance, which includes daily activities that ensure the continuous availability of the road, like roadway and shoulder maintenance, drainage and winter maintenance; (3) periodic maintenance, the management of pavements and the planning of activities required to return the state of the road to its original condition by repairing road damage and thereby substantially altering the asset condition and finally; and (4) operation of roads, which mainly includes incidental traffic and safety services.

An experiment or gaming-simulation is at first as any other artefact under construction. Therefore the principles of engineering design are also applicable. As pointed out by engineering design theory (Dym and Little 2004) design requirements may prescribe; a) Values for particular design features; b) Procedures with which attribute performance will be calculated; and/or c) Performance levels that must be attained by the design. The list of design requirements presented in this section includes all these different aspects.

As element of this study the main purpose of the game is of course to contribute in answering the overall research question, formulated as: *How to achieve the results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (of contractors) and the (negative) effects of it at the minimum possible?*

Within this central research question, the gaming-simulation exercise focuses on the issue of how to limit opportunistic behaviour in innovative contracts. Therefore specific questions that the gaming-simulation developed aims to answer are: *If contractors are given the freedom, what trade-offs will they make? And what will the long-term consequences be in terms of network condition, government finances and competitiveness of the private sector?* These questions pose the need to gather a certain type of data -like private information and financial statistics of contractors- which guided not only the design of the game but of the specific forms used throughout the gaming sessions.

Further, answering these questions with enough validity requires the generation of enough runs of the simulation exercise, so as to be sure that the results recorded are not the product of incidental conditions and are consistent enough to let base conclusions on. An important part of the requirements stem from the combination of these two aspects, the need to answer this particular set of questions and ensure a certain number of runs.

The result is the following list of functional design requirements[2]:

- The exercise should allow learning for people of different institutional contexts. The game should be a tool to be used in different countries with different legal or regulations, at least valid for the three countries covered by the research. In this sense it should allow to participants to add themselves the institutional features of their countries (which often they do) but also allow them to test new alternatives -not necessarily stemming from their current contracting practices- what is called "thinking out of the box".

[2] As explained in Chapter 2, only a limited number of design alternatives in the design space can satisfy all requirements for a system; which include functional and non-functional requirements. Functional requirements define what a system is supposed to do, they describe specific and necessary system functions. A design is said to be correct if it satisfies all functional requirements. Meanwhile non-functional requirements relate to criteria that can be used to judge the operation of a system, rather than specific behaviours. They relate to the remaining characteristics of a system and are often called qualities of a system, or alternatively "constraints", "quality attributes", "quality goals" or "quality service requirements".

- It should be verifiable. Even though it requires a simplification of reality, the resulting design should be still close enough to reality -in terms of outcomes- so as allow for validation and verification. For this reason it should include elements related to road condition and should allow the development of experiences or behaviour that could be discussed or compared with the participants' experiences of reality.
- It should capture the main tension between increase in design freedom and opportunistic behaviour. It should allow therefore for the generation and recording of private information of contractors.
- It should be possible to validate and compare results between different sessions (validation and comparability). This means that a minimum number of sessions should be ensured and changes in session design should be kept limited. Accordingly the final design keeps the type of contracts and impact analysis fixed and only allows for the simulation of different market structures.
- It should be relatively easy to extend or expand to include other aspects of contracting or types of contracts deemed important by future users. It design should be therefore modular so as to allow the introduction of additional roles like engineering consultants (working for either the road authority or the contractors) and/or additional life cycle phases like design and construction.

Further non-functional requirements, in the context of this study are:

- It should involve as little facilitation effort as possible, up to a maximum of two facilitators. Accordingly the final game design limits itself to the simulation of a monopsony, a market where a single client (road authority) faces many sellers (contractors).
- Maximum time required for a session is half a day, three to four hours.
- The game can be played by people with different levels of knowledge -like students and practitioners- without compromising the validity of the results.
- It offers considerable benefits and learning also to participants, not only to researchers. Accordingly the complete gaming exercise should include a debriefing or discussion phase and cannot be kept as abstract as the experiments commonly used in behavioural economics or game theory.

Finally, taken into account the specific purpose of the gaming exercise, within the overall research project, three additional requirements are:

- The game research outcomes, understood as the data gathered during the sessions and the lessons learned during debriefing are practically ready to be implemented as policy advice by different road authorities. In other words, the translation of research outcomes in policy advice for the problem owners does not require excessive effort or multiple rounds of interpretation/elucidation that lessen the validity of the conclusions. Consequently the need to leave total freedom to players and not assign fixed ranges to contract incentives -bonuses and

penalties- and other policy variables; and the need to keep limited the number of variables included in the game so as to ensure that conclusions are not too casuistic or difficult to generalize. The first aspect will make Road Roles differ from the experiments proposed by game theory, while the make it differ from the majority of gaming-simulations developed up till now.

- The game design allows continuous discussion and evaluation of results and players strategies. Therefore there is a need to keep the use of computers limited to a minimum and to include time for debriefing.
- It allows learning about the effect of incentives in the short and the long-term. Therefore in the simulation, the set-up is aimed at continuity in time, one tendering round after another with the results of previous rounds affecting subsequent rounds.

6.4.2 Step 2: System analysis of the problem being addressed

In this step the objective is to clarify the problem; by defining both focus and scope. As described by Wenzler (1996), system analysis is an interactive process during which the design team analyses the problem environment and develops the conceptual model of that environment. This model is the base for the design process. Duke and Geurts (2004) recommend organizing the system analysis task by dividing the team into two groups; one that works with members of the organization and their stakeholders using interviews and workshops; and the other one seeks to find conceptual models and generalizations from multidisciplinary, academic and professional literature, statistical data, and if relevant, outside experts. This last group looks for potential frames of "reconstructed logic".

Different in order, but along the same lines, the process followed was first the construction of a general conceptual framework - based on literature review and interviews with experts- ; second, a field research was conducted - more than 15 interviews per country and workshops with different stakeholders- and finally, when the focus on periodic maintenance was set, a further work has been done on extending the conceptual framework.

The results from the system analysis were presented in detail in Chapter 3. This chapter also gives an overview of the issues at stake in the sector of road maintenance, common to all three countries researched. This understanding of the system built in chapter 3 and based on field research, is crucial for a proper design of the gaming-simulation; a design that is applicable to these three countries and other with comparable reform plans. In order to make the game design process more accessible to the reader, excerpts of the in-depth analysis presented in Chapter 3 will be repeated in the following subsections.

The sector of periodic road maintenance

As mentioned before, future reform plans are either to combine periodic maintenance with routine maintenance activities, or to assign different areas or tasks to the actors already active in the periodic maintenance sector, mainly contractors, consultants (design and geotechnical issues) and of course to the road authority itself.

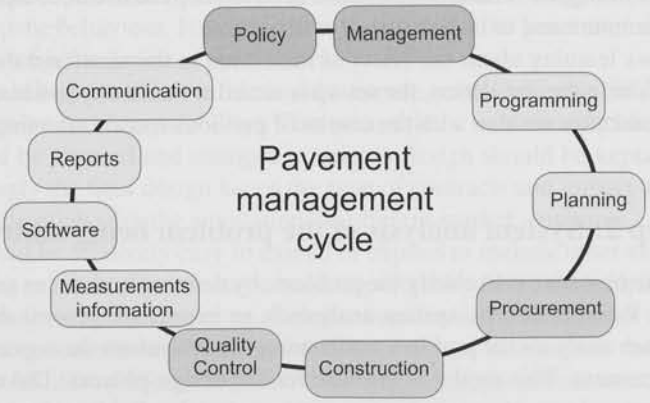

Figure 6.1: *Pavement management cycle (Translated from Finnish. Source: Ramboll Finland Oy 2006)*

Pavement management cycle

A pavement management program consists mainly of tasks such as Policy, Management, Planning, Programming, and so forth, progressively translating very general guidelines into a concrete list of "works" to be realized by each district or region and further into a set of contracts to be tendered. The following figure shows all the consecutive phases common to all pavement managements programs or so-called Pavements Management Systems (PMS) nowadays in place in nearly all developed countries, and promoted by the World Bank also -though following a somewhat adapted own model- in many developing countries (Finn 1998). PMSs have been implemented by national road authorities in the Netherlands since the late 80s, and in Finland and Spain since the early 90s.

As it can be observed in the Figure 6.1, a PMS provides the framework within which to organize and carry out all the work activities needed to provide and maintain the national pavements network. It has been also defined as a system which involves the identification of optimum strategies at various management levels and maintains pavements at an adequate level of serviceability (riding comfort) (Finn 1998, 4); or a systematic process that provides, analyses and summarized pavement information for

use in selecting and implementing cost effective pavement construction, rehabilitation, and maintenance programs.

As stated before these phases are similar in all national systems (Molenaar 2005); nevertheless differences may exist in the list of criteria or weight assigned to them, used as basis for the final decision on which maintenance works are prioritized and for which rehabilitation strategy is chosen. Alternative decision models between many are the conventional network optimization model, a model based on financial consequences (Bemanian et al. 2005) or the so-called "Lifetime-Extending-Maintenance" model (Stijnen and Noortwijk 2004) developed and used in the Netherlands.

Until recently the regional offices have done the programming, planning and procurement themselves, with support from consultants. Nevertheless plans are to organize contracts in such a way that, either a contractor takes care of the whole process starting even from planning and hire consultants as subcontractors; or the other way around, consultants may do all the activities from programming on and hire themselves construction contractors. In total there are four possible scenarios that will be discussed later.

Actors

"The process of identifying and creating the knowledge which is relevant to the problem environment starts with identification of main (real-life) actors within that environment" (Wenzler 1996). The most important actors in the sector of periodic maintenance are the national road administration or road authority, road authority regional offices, contractors, design and engineering consultants, users and residents.

Some of these actors are more directly involved than others in the contracting practices of the road authority. Depending on the scenario or arrangement chosen for the future, some will have a more predominant or decisive role than others. Nowadays consultants have still large authority and predominance in terms of knowledge and expertise; since they work directly for the road authority and are the ones preparing tendering documents, detailed designs and even conducting quality monitoring of consultants. However, this power balance may change when contracts for the whole life cycle and entire networks are given to contractors and these are the ones directly buying services from consultants. Such a change of roles and the finding of a new power balance has already happened -to varying extents per country- in the area of capital projects when Design-Build contracts were introduced. After years of tense relationships consultants have found a new role as partners of contractors.

Alternative scenarios

Possible future scenarios for the maintenance of roads that could be simulated by the game are the following:

(1) Traditional situation: where road authority tenders out a specific section of the road and prescribes a specific action and mix of bitumens.

(2) Contractors are hired to repair a specific section of road, not told exactly what to do, but expected to give a guarantee of five years or more.
(3) Contractor takes care of a whole area, programming and planning, is paid a fixed service fee per year (lump sum) and in coordination with design consultants perform the necessary work activities to ensure a certain service level or annual objective (e.g. 80% of roads are in sufficient condition).
(4) Design consultants take care of a whole area, they are paid a fixed service fee and they are the ones who hire construction subcontractors and look after the quality of their job, in order to ensure a certain level of service.

As it will be explained later, a choice has been made for scenario three. This is the scenario considered to be the more innovative one and at the same time the one more interesting to be explored given the ample freedom that would be granted to contractors in this case. Since in this scenario it becomes more important to research the trade-offs that contractors would make and how will they use this newly granted design freedom; it has been decided to simplify the game plot by leaving aside the role of the consultants.

Scenario four, though also very innovative, is not an option, since the practical implementation of such a scheme remains very difficult; mainly since consultants up to now have not developed the same capacity as contractors to bear risks.

6.4.3 Step 3: Transformation of the conceptual model into a gaming model

Model transformation is an interactive process during which the conceptual model is transformed (in all of its qualitative and quantitative aspects) into a dynamic gaming-simulation model (Wenzler 1996).

The first step is the selection of components that will be included. In order to arrive to a manageable game the real situation was simplified in the following ways. First, the relationship consultants-contractor was simplified such that the road authority deals only with contractors, where it is assumed that contractors and consultants will act as one in a cooperative way; second, only one organizational level of the road authority is played, the regional level; third, the role of the other government layers are assumed by the facilitator; and fourth, only one scenario is played. It was decided to simulate the future (expected or desired) reality - choosing the most ambitious scenario out of the four possible scenarios for periodic maintenance. Other options were to focus on the existing reality or in the transition from existing to future reality.

The second step is the creation of the system components/ gaming elements matrix. This matrix is a tool that helps translating the knowledge contained in the conceptual model into elements or building blocks of the gaming/simulation exercise, such as roles, rules, scenarios, format, style, steps of play, accounting system, events, visuals and paraphernalia (Duke and Geurts 2004).

All these steps were followed in order to develop the game prototype presented in Section 6.5.

6.4.4 Step 4: Development and testing of the game prototype

During this step, the prototype is run through a series of "talk-through(s)", "crawl through(s)", "walk through(s)" and "run through(s)", each one increasingly more rigorous (Duke 1980). Once these first level tests have been applied, the game is fully played to realize the so-called "test runs". As Wenzler (1996) states "Parallel to the test runs the process of incremental design modification and implementation of changes in the construction of the exercise is taking place. The changes reflect the learning obtained through testing" (Wenzler 1996, 14).

Table 6.1: *Tests applied to the initial prototype*

Aspect	Test 1	Test 2
Objective	Test mainly playability of the game and learning potential	Test mainly validity and verisimilitude of the game setting and results
Location	Delft, The Netherlands	Helsinki, Finland
Group	10 Master students of the Faculty Technology, Policy and Management	8 Experts in roads and pavements
Knowledge of the content or sector	Limited but knowledge about gaming techniques	Extensive
Context of use	Session of Design a Game course	Continuation of a meeting of periodic maintenance experts from a prestigious consultancy company
Homogeneity	High	High
Rounds played	5 tendering processes	4 tendering processes
Contractors	4 companies	3 companies

The end result of this step is a fully playable prototype of a gaming-simulation exercise, which is presented in the following section. Table 6.1 gives an overview of the two times the game was tested; apart from the many times it was partially and internally evaluated by walking through the different steps.

The goals of these tests or the so-called technical evaluation include checking on the generic criteria of validity, verisimilitude, playability and operability of the game. With the help of game participants and few experienced observers a thorough review of the improvements needed -for each of these criteria- was realized. Following the main outcomes from this review, the main changes realized were in:

- Research and Development (R&D) cards: possible new technologies were researched and formulated with the help of road specialists from the mentioned consulting company. Also with them their effect was checked and adjusted.

- Recording the game results: a complete set of extra accountability forms was developed in order to keep better track of choices made by contractors and road authority. These new forms allow the tracking of contractors' private information.
- Official communication cards: two new types were introduced that aim at including environmental aspects in the tendering process and preventing excessive (non realistic) differences in contractors cost structures and performance.
- Verisimilitude: in order to better represent the different national conditions in the sector of maintenance, it was agreed to vary the number of contractors and their cost structures so as to represent the different market structures.
- layability: a support tool to calculate work plans that would fulfil road authority requirements and their cost was developed for contractors.

6.5 Road Roles: resulting prototype

This section presents the final prototype of Road Roles after the changes recommended were implemented. At least, as it was implemented throughout the subsequent twelve game sessions. It should be emphasized that "in fact there may never be a time when a "final" game exists. More likely the users will find that continuous modification of the game is productive throughout the lifetime of its use" (Duke 1980, 375).

6.5.1 Subject matter

Road Roles simulates the future situation in road maintenance at an abstract level. Instead of the traditional prescriptive contracts, long-term and performance-based contracts are used to provide periodic maintenance for a whole road network. Traditional contracts prescribe the kind of work that needs to be done in a specific section of the network. Performance-based contracts increase contractors' freedom to a maximum level, the contractor decides which road section, when and what kind of work he will perform, with the only condition of keeping a certain level of performance for a whole road network within a specific area or district for a certain number of years.

6.5.2 Road Roles research questions

As mentioned before, Road Roles aims to explore the following questions:

- If contractors are given the freedom, what trade-offs will they make?
- As a consequence of these choices, will the quality of the road network decrease or increase?
- Will the road authority be able to monitor and control contractors?
- Will the efficiency of the sector improve?

- How will the private road maintenance sector develop?
- Will contractors innovate and become more professional and specialized?
- How will the market develop?
- Will it become a competitive market or an oligopoly with few players holding most of the power?

6.5.3 Game organization

Two types of players play an active role in the game: the contractors and the road authority. The facilitator plays other roles, like the bank, central government, consultants and all other external factors.

In a few words, the game is organized as follows. Firstly, the road authority issues an invitation to tender for the maintenance of a complete network consisting of five road sections. Secondly, contractors present an offer and compete for the contract. Then, the winner maintains the road network in order to make money. After the work plan of the winning contractor has been implemented in the network condition simulation model (impact analysis) the condition of the network at the end of the four-year contract is reported to the authority and a new tendering cycle begins. The detailed steps followed per tendering round will be presented below.

An actual gaming session, consisting of 3 to 6 tendering rounds; ends with a debriefing session to discuss the results of all players - the contractors in terms of money, and authority in terms of the condition of the road network.

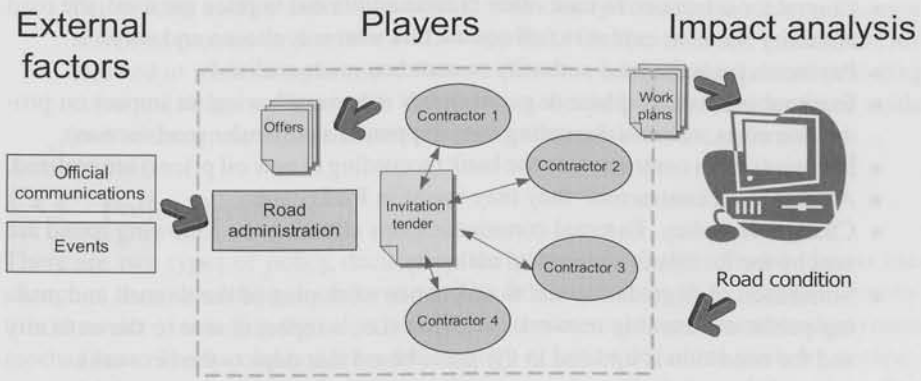

Figure 6.2: *Game set-up*

Macrocycle sequence

A complete gaming session -that takes around four hours- is structured in three different phases:

(1) *Introductory cycles*: A presentation is given about the paraphernalia of the game, the meaning of the road condition states, the board and the accounting system to be used. Afterwards, one tendering round is played just for warming up and clarifying the last details.
(2) *Tendering rounds*: Once all players are familiar with the logic of the game, the real playing starts and this means a succession of 3 to 6 rounds of tendering, depending on the time available. A total duration of around 25 minutes per round has been planned. The sequence of activities in a tendering round is fixed and it will be explained below.
(3) *Debriefing*: Once all tendering rounds are finished the results of all the players, contractors in terms of money and road authority in terms of resulting road conditions are presented and used for the debriefing. The main questions discussed are a) What are the results - in terms of road network condition, contractors finances and R&D- of the tendering terms conducted? And b) How does this experience relate to the real contracting problems in the Road Sector?

Microcycle sequence

The sequence of pulses within one single tendering round is more or less the following:

- Invitation to tender made public by the road authority.
- Tendering. Contractors prepare a maintenance plan and deliver their proposed plan to road authority.
- Contractor selection. In case other criteria additional to price are used, the road authority needs to explain to all contractors who was chosen and why.
- Payments from the road authority to contractors are realized
- External events take place (e.g. oil prices may vary having an impact on production costs, or extra degrading may happen in a particular road section).
- Payments from contractors to the bank (according to new oil prices) are realized.
- Actions from contractors: they may invest in R&D cards.
- Changes in policy. External communications affecting the following round are sent by the facilitator to the road authority.
- Simulation of degradation and maintenance work plan of the winner, and making public of resulting network condition (i.e. a report is sent to the authority and the condition is updated in the game board that depicts the network).

6.5.4 Essential design elements or modelling choices

Besides the design choices relating game organization, a number of other modelling choices have been made. The most important follow:

(1) Invitation to tender. Every four years, the road authority formulates an invitation to tender, consisting of a set of selection criteria and requirements (e.g.

minimum quality required, bonus and penalties), which they can change at their discretion at the beginning of each round of tendering.

(2) Contractors' maintenance plan and upgrading impact of maintenance actions. In response to this invitation, contractors prepare a maintenance plan. On the basis of this work plan, which is private information, they calculate a price and any other additional information required, and submit their bid. The work plan is a list of work activities, including both heavy and light actions, to be carried out for each road section of the network during each of the four years of the contract. Heavy actions have twice the impact of light actions in upgrading the condition of the road and natural degradation is modelled to vary at random within certain limits.

(3) Contract uncertainty. Uncertainty has been modelled through event cards that can change the cost structure of contractors or network deterioration rates, and through official communications cards that announce changes in government policy.

(4) Contractors' competitive advantage and sector innovation. Contractors can gain a competitive advantage by investing in Research and Development (by buying R&D cards).

(5) Contractors' installed capacity. The capacity of the firm is taken into account. All contractors except the winner pay 50 units of fixed costs per round. This represents the penalty for having unutilized capacity and makes the need for winning a contract more urgent as the game progresses.

(6) Validity of rules. As mentioned before, the road authority may change the rules, but as long as they can communicate with clarity to contractors how this new selection process or formula will be applied. On the contrary, contractors are allowed to file a complaint and that would cause additional legal and tendering costs and delay on the works. All changes should be communicated and made part of the tendering invitation, otherwise they could not be enforced.

6.5.5 Policy decisions

There are two types of policy decision in the game, which the relevant players can change at their discretion in each round. The first one relates to the authority invitation to tender - including the selection criteria, contractual requirements and payment mechanisms. The second concerns the strategy or action decisions made by contractors, which are reflected in their internally prepared work plans and the prices they offer publicly.

6.5.6 Impact analysis

A computer model that simulates road condition was developed to realize the impact analysis. The model uses the work plan of the winning contractor as its input and computes the new condition of the network, also taking account of the initial condition

and the natural rate of degradation for each section. The categorization of roads in five condition groups- very good, good, reasonable, mediocre and bad- is used by many countries around the world. In Road Roles, a qualitative categorization of roads according to a number of stars has been chosen. The condition of each road section can vary between zero and five stars, five being the best condition possible and two representing the minimum required for normal use of the road.

6.5.7 Scenarios

In this game, the type of contract is a fixed, long-term rehabilitation contract, but different scenarios are played that reflect the different market structures in different countries, varying the number of contractors (three to five), their start-up capitals (all equal or one contractor has three times more capital) and their cost structure (all equal or two contractors are more efficient).

The model simplifies reality by including the authority and contractors but leaving consultants and users out of the game, while maintaining the essence of the strategic setting.

6.6 Field use and evaluation of Road Roles

This section presents two main aspects of the continuous process of implementation (phase 5), the variety of experiments conducted and uses given to the simulation developed and the main results of the evaluations conducted by participants during the debriefing of each session. These two aspects cover in fact two steps denominated by Duke (1980) in his paper "A paradigm for game design" as step 8: game evaluation and step 9: field use of the gaming-simulation.

6.6.1 Experiments conducted

A generic version of the game was developed in late 2006 and after many test-runs (with game experts and road-pavement experts), a verified and fine-tuned version has been played 14 times in three countries[3] (the Netherlands, Finland and Spain). Eight of these sessions involved professionals and experts in the area of innovative contracting, while six involved engineering students. Although students and professionals did not behave fundamentally differently, students tended to make more radical (but not necessarily worse) choices.

[3] In the Netherlands it has been played in sector activities like the Road Administrators Day in October 2007 and the Information and Technology Centre for Transport and Infrastructure (CROW) symposium in November 2007; and with organizations like the Dutch Maintenance Society, Deltares (international research institute), the Asset Management Platform of the Next Generation Infrastructures Foundation, the Innovation Program of the Dutch Road authority (IPW - Rijkswaterstaat) and Rotterdam Port Authority. In Finland it has been played with road experts of the consultancy company Ramboll.

6.6.2 Positioning of the different game sessions

As explained before, the three most characteristic and colourful game-runs will be highlighted and described in more elaboration. Tables 6.2, 6.3, 6.4, and 6.5 present a list of 15 criteria that were taken into account for the selection of the three cases -out of 14- to be analysed and presented in further detail in this chapter.

These 15 criteria are divided in six main categories. The first, game session set-up, cover the three main attributes of the session, with no value judgement attached to them. These first three criteria served as pre-selection criteria. Preference was given to sessions where the final prototype was used (disqualifying the first two sessions) and with similar duration in number of rounds, so as to allow for a fairer comparison of long-term results.

The second category, road authority rules, can be considered as the set of main explanatory variables (instruments) for the overall performance of the game session. These variables determine the results in combination with the variables included in categories three and five, valuation of road authority rules and contractors' behaviour. For these two categories of variables it is difficult to make a clear distinction if they should be considered input (instruments or external factors) or output variables. The following two examples explain why.

- First, let us take use of opportunistic behaviour. This variable -as observed- combines two aspects. On the one hand we have the natural tendency of players to act in this way, which is an external factor introduced by players and their cultural and institutional backgrounds. On the other hand we have the impact of authority rules in limiting or even promoting further this natural tendency, which already contains the effect of the instrumental variables applied by the authority.
- The second, formulation of rules, is a similar case. The observations that determine the value given to this variable are again a combination of two aspects. First, the internal consistency of rules and their intrinsic formulation (instrumental or input variable); second, the consequences of these rules as experienced by contractors (complains filed and financial consequences) and by the authority (in terms of network condition received after four years of contract). This last criterion was in fact one of the hardest to value. Poorly formulated rules can be recognized not only by their direct or immediate effect on the results received by the authority (authority financial performance and network condition) but also by the disadvantageous circumstances faced by the private sector (some rules lead contractors to bankruptcy).

Finally, categories four and six, all output variables, value the performance of the session and the success of the road authority in terms of direct or short-term effects and indirect or long-term effects. These last effects take place through feedback mechanisms and undergo a time delay, as explained in Chapter 3.

The three cases selected -as highlighted in Tables 6.2 to 6.5- not only cover the whole spectrum of possibilities per criterion, but also offer a combination of features that allows for a clearer exploration and understanding of the mechanisms at hand in the overall contracting system and for the illustration of the consequences of the new contracting practices. Important to clarify is that the common patterns and findings presented in Section 6.8 are based on the observations of the full set of sessions.

Table 6.2: *Positioning of game sessions according to multiple criteria, part A*

SESSION DETAILS			1. GAME SESSION SET UP											
	Participants	Short name	Market structure [a]				Participants knowledge			Session Duration [b]				
			3 (equal)	4 (2 with CA)	4 (equal)	5 (equal)	Limited	Medium	Extensive	2	3	4	5	6
1	Dutch MSc Students Game Course	DSGC			■		■					■		
2	Finnish Pavement Professionals	FPP			■				■			■		
3	Dutch MSc Students Game Course	DSGC(2)			■		■			■				
4	Dutch master Students of TUDelft (different specializations)	DSTU		■			■							■
5	Spanish MSc Students Industrial Organization	SSIO			■		■					■		
6	Dutch Procurement Professionals	DPP		■					■			■		
7	Dutch MSc Students (Politics of) Policy Analysis	DSPA				■	■					■		
8	Dutch Phd Researchers Technology, Policy & Management	DRTPM				■		■					■	
9	Dutch Geo-Engineering Professionals	DGEP		■					■			■		
10	Dutch PPP Experts	DPE			■				■		■			
11	Dutch Infrastructure Maintenance Professionals	DMP	■						■			■		
12	Dutch Maintenance Restructuring Experts	DMRE			■				■			■		
13	Dutch Asset Management Professionals	DAMP			■				■			■		
14	Dutch Procurement and Project Management Professionals	DPMP			■				■			■		

[a] Number of contractors and competitive advantage

[b] Number of tendering rounds

6.6.3 Game evaluation: outcomes and mechanisms

After the first two rounds of testing and adaptation, ever since the final prototype has been implemented, it has been in continuous evaluation by the various user groups from which some people also acted as participants in one of the game runs. The

Table 6.3: *Positioning of game sessions according to multiple criteria, part B*

SESSION DETAILS			2. ROAD AUTHORITY RULES (Explanatory variables)												3. VALUATION OF ROAD AUTHORITY RULES (Input and effect)								
	Participants	Short name	Negative Incentives [a]					Positive incentives [b]				Monitoring [c]			Selection criteria [d]			Formulation of Rules [e]				
			Very large	Large	Medium	Low	No	No	Not significant	To some extent	Significant	No (never)	Middle (some rounds)	Yes (almost all rounds)	Only price (used)	Price dominant (but others tried)	Other dominant (Max 1 round)	Very good	Good	Medium (moderate)	Bad	Very bad
1	Dutch MSc Students Game Course	DSGC																				
2	Finnish Pavement Professionals	FPP																				
3	Dutch MSc Students Game Course	DSGC(2)																				
4	Dutch MSc Students of TUDelft (different specializations)	DSTU																				
5	Spanish MSc Students Industrial Organization	SSIO																				
6	Dutch Procurement Professionals	DPP																				
7	Dutch MSc Students (Politics of) Policy Analysis	DSPA																				
8	Dutch Phd Researchers Technology, Policy & Management	DRTPM																				
9	Dutch Geo-Engineering Professionals	DGEP																				
10	Dutch PPP Experts	DPE																				
11	Dutch Infrastructure Maintenance Professionals	DMP																				
12	Dutch Maintenance Restructuring Experts	DMRE																				
13	Dutch Asset Management Professionals	DAMP																				
14	Dutch Procurement and Project Management Professionals	DPMP																				

[a] Use of penalties and their weight
[b] Use of bonuses and their weight
[c] Use of any type of monitoring or other additional meaures to limit opportunistic behaviour
[d] Dominance of price in final selection of winner
[e] Clarity, gaps, inconsistencies and inmediate effect on market

Table 6.4: *Positioning of game sessions according to multiple criteria, part C*

SESSION DETAILS			4. ROAD AUTHORITY PERFORMANCE (Direct effect)									5. CONTRACTORS' BEHAVIOUR						
	Participants	Short name	Financial control[a]			Efficient use of funds[b]			Network cond. control[c]			Use of opportunitic behaviour[d]				Collusive behaviour[e]		
			Good (savings)	Under control (averaged out)	Out of control	Good	Middle	Bad	Good (no closings)	Medium (slightly under control)	Bad (Out of control)	Low	Moderate	High	Extensive	No	Middle	Large
1	Dutch master Students Game Course	DSGC																
2	Finnish Pavement Professionals	FPP																
3	Dutch master Students Game Course	DSGC(2)																
4	Dutch master Students of TUDelft (different specializations)	DSTU																
5	Spanish Master Students Industrial Organization	SSIO																
6	Dutch Procurement Professionals	DPP																
7	Dutch master Students (Politics of) Policy Analysis	DSPA																
8	Dutch Phd Researchers Technology Policy & Management	DRTPM																
9	Dutch Geo-Engineering Professionals	DGEP																
10	Dutch PPP Experts	DPE																
11	Dutch infrastructure Maintenance Professionals	DMP																
12	Dutch Maintenance Restructuring Experts	DMRE																
13	Dutch Asset Management Professionals	DAMP																
14	Dutch procurement and Project Management professionals	DPMP																

[a] Spending within or above budget assigned
[b] Profit levels of contractors selected
[c] Number of road sections closed and fluctuations in road condition
[d] Shown in profit levels planned, network condition and cheating
[e] Depending on the effect or profit levels

Table 6.5: *Positioning of game sessions according to multiple criteria, part D*

SESSION DETAILS			6. MARKET DEVELOPMENT (Indirect or long term effects of authority rules)					
	Participants	Short name	Market concentration[a]			Sector Innovation[b]		
			Small	Medium	Large	Poor	Medium	High
1	Dutch master Students Game Course	DSGC		2 of 4 (no record available of differences)			7 cards	
2	Finnish Pavement Professionals	FPP			1 of 4 (Large differences from -390 to +850)		9 cards	
3	Dutch master Students Game Course	DSGC(2)			2 of 4 (Large differences from 0 to +1100 and +100)		7 cards	
4	Dutch master Students of TUDelft (different specializations)	DSTU			2 of 4 (Large differences from -900 to +200) very large differences in effect of actions (1,6 & 2,4 versus 1 & 2)			36 cards
5	Spanish Master Students Industrial Organization	SSIO			2 of 4 (Large differences, from -1000 to +350)		7 cards	
6	Dutch Procurement Professionals	DPP			2 of 4 (Large differences, from -540 to 600)		7 cards	
7	Dutch master Students (Politics of) Policy Analysis	DSPA		2 of 5 - but in 0 (all bad, medium differences from -400 to +0)				20 cards
8	Dutch Phd Researchers Technology Policy & Management	DRTPM		3 of 5 (medium differences) from -50 to +445)			6 cards	
9	Dutch Geo-Engineering Professionals	DGEP		2 of 4 (small to medium differences) from -350 to +165)			4 cards	
10	Dutch PPP Experts	DPE	4 of 4 (small differences from +50 to +625)			0 cards		
11	Dutch infrastructure Maintenance Professionals	DMP	2 of 3 (small differences from -50 to +360)			2 cards		
12	Dutch Maintenance Restructuring Experts	DMRE	2 of 4 (small differences from -50 to +360)			2 cards		
13	Dutch Asset Management Professionals	DAMP			1 of 4 (large differences - the winner has also competitive advantage- cheaper actions)		10 cards	
14	Dutch procurement and Project Management professionals	DPMP		2 of 4 (Medium differences from -510 to +150)		1 card		

[a] Number of contractors and differences in the end

[b] investments in R&D in number of cards, independent of effect

sessions with professionals have been particularly informative.

As previously mentioned, evaluation and learning for participants is done as part of the debriefing that takes place at the end of each session. The questions discussed during debriefing are a) what are the results - in terms of road network condition, contractors finances and R&D- of the tendering terms conducted? And b) how does this experience relates to the real contracting problems in the road sector?

The different groups of professionals have evaluated as valid or legitimate the various assumptions embedded in the gaming-simulation design as well as in the impact analysis model, and agreed on the level of difficulty of the exercise (determined mainly by the number of road sections and types of actions considered). Besides, their most important remarks concerning the mechanisms, behaviours and long-term effects experienced during the game could be summarized as follows:

(1) *Contractors' behaviour*: some are faster to adapt and react to economic incentives than others, but in general all contractors are very sensitive to the incentives built in the contract. In particular for innovative performance-based contracts this often lead to bids under the total cost either because bonuses are already being discounted from the profit calculated or contractors' are hoping to make the additional profit needed by exploiting certain weak clauses of the contract. Players agreed that opportunistic behaviour of contractors becomes apparent during the game session and depicts the behaviour experienced by them in diverse large infrastructure projects.
(2) *Market dynamics*: even though often contractors begin with similar cost structures, the market move fast towards an unbalance, with few players holding strong competitive advantage. This was as well recognized as a valid characteristic of these new large-scale integrated contracts.
(3) *Innovation in the sector*: often contractors -especially when played by real contractors- were not so enthusiastic about investing in R&D cards did not sustain their investments after experiencing a single card with no results. This also seemed to fit the general conservative and risk-averse attitude of the private contracting (construction) sector towards risks associated with investments in research and development or implementation of new technologies.

Finally, participants agreed that the gaming exercise allowed them to experience first hand and to grasp concepts -very difficult to explain through other instruction methods- like:

- the ratio or desired proportion between contract value and economic incentives, especially penalties or deduction;
- the tension between different authority requirements - like keeping the hindrance to traffic to a minimum, while also ensuring enough maintenance for the road network;

- the effect of excessive penalties on the financial health of the private sector and on the informal sphere of the sector;
- the difficulty of steering contractors in the new setting of performance-based contracts, where it is not any more possible to tell contractors exactly what they should do, but only indirectly through economic incentives; and
- the difficulty of judging contractors' offers or bids without knowledge of the price structure or price composition. The road authority rapidly loses touch with how much a certain level of service actually cost.

The participants' observations stem from their experiences in specific infrastructure projects as consultants, contractors and network managers- not only of road networks but also from a variety of infrastructure sectors (railways, ports and water facilities). This last fact points towards the applicability of research results and of Road Roles itself in other infrastructure sectors applying this kind of performance-based contracts for the maintenance and/or constructions of their networks.

It is important to recall here two assumptions or modelling choices embedded in Road Roles that may pose a limitation for its application in other sectors and/or that require consideration when interpreting the outcomes of the gaming-simulation.

The first is that -given the choice for gaming-simulation as method- the entry of new companies is not possible. Nevertheless this is an assumption not far from reality for asphalt businesses; since to open a new (hot mix) asphalt plant so many environmental and other government permissions are needed (hot mix asphalt plants are required to obtain air pollution permits).Besides given the nature of the material, asphalt plants must be located (strategically) fairly close to road construction sites. Paving is difficult at lower temperatures, and highway contractors must reject asphalt that is not hot enough (at least 250 degrees). If the game is to be applied to other sector or market when this assumption does not hold, alternative ways of allowing for the entrance of new players halfway should be found.

The second -partly the result of facilitation constraints- is that a single (public) client has been assumed. Given the importance of installed capacity in the construction sector, the inclusion of more public clients offering different types of contracts and incentive schemes, may improve the correctness of the results in terms of the magnitude of market concentration and market power that could be exerted by companies in case their need to win a contract is lower than when having a single client.

In addition to these ongoing discussions the methodology has been evaluated by two independent external committees; the project team in charge of Program for Innovation and restructuring of Maintenance activities (IPW) within the Dutch Road Authority (Innovatieprogramma Wegbeheer - RWS) and the Maintenance and Operations Management Committee (AHD10) of the American Transportation Research Board. Both committees have concluded positively about the maturity of the product or exercise, its relevance and contribution to the state-of-the-art or practice, its originality and timeliness, and the technical soundness of the methodology applied. The Dutch com-

mittee - which had first hand experience of the exercise- also concluded positively on the high learning return of the gaming session and its significant game theoretic component. This last aspect distinguishes Road Roles from other so-called knowledge games. In Road Roles the interdependency between the different strategies of players is visible, the success of one strategy depends of the strategies of others and previous experience in playing the game -especially in the role of contractor- does not necessarily results in advantage in comparison with new players.

Summarizing, it can be concluded positively about the validity of the gaming exercise propose. The goals for which it has been designed seem to have been achieved; the resulting design -according to the experience and valuation by participants and independent committees- appears to satisfy all functional requirements formulated. First, since it allowed learning for people of different institutional contexts; it proved verifiable and the game outcomes were judged as valid by participants; and it proved effective in capturing the tension between design freedom (contract flexibility) and opportunistic behaviour. Second, enough number of sessions have been played which facilitated the process of validation and allows for the comparison of results between different gaming sessions. Third, the preliminary phase of an undergoing research project based on this first prototype has indicated that the current design is indeed relatively easy to expand so to include other relevant aspects of innovative contracting (e.g. the role of engineering consultants firms).

6.7 Connecting strategies with outcomes in three typical cases

Three out of the fourteen experiments conducted have been selected for further qualitative and quantitative analysis. As demonstrated in Section 6.6.2, these experiments are fairly representative of the total set, but present a combination of features which illustrate the array of mechanisms behind the contracting practices more clearly.

Each experiment will briefly be described, followed by an analysis of the changes in the strategies of the road authority and contractors, in order to provide a clear overview of the key factors in each experiment. Subsequently, in the light of these factors and a comparison of how each road authority performed, a set of lessons learned from each session will be outlined. To conclude, main differences and similarities recorded between these three sessions will be discussed.

6.7.1 Brief description of experiments

The case of the Spanish students

The set-up of this experiment was characterized by four contractors with equal resources and cost structures. The players were 25 engineering students from the Tech-

nical University of Navarra.

First round

The only selection criterion was price, meaning that the contractor making the lowest bid won the tender. The requirements set by the authority were an overall condition of three stars, with four stars for two of the sections. These requirements were not in agreement with the fine of 100 per section with final condition under three stars. The winner performed three Heavy and two Light Actions, which was not enough to fulfil accomplish the requirements. He received a bonus of 50 and a sanction of 200, making a loss of 150 out of 725 (bid value).

Second round

Environmental friendliness was added to the list of selection criteria, although the cheapest contractor again won the contract. Additionally, the introduction of a reliability grade as selection criteria for future rounds was announced. The requirements and incentives remained the same, except that no bonus was offered and an additional penalty for very badly performing contractors - the threat of expulsion - was added. The winner performed no actions on the road network, bringing the network condition from 2.8 down to an average of 0.8. He had to pay a sanction of 500, but since he received a payment of 800 and had no costs, he made a profit of 300 out of 800.

After tendering, it was announced that sections four and five had become a main European corridor and therefore a minimum condition of four stars had to be ensured.

Third round

With an augmented budget of 1,200, there were no changes in the list of selection criteria. The requirements and incentives remained the same, except that a minimum of four stars were required for sections four and five, while it remained at three stars for the other three sections, and the penalty was raised to 300 per section falling below the final condition required. The requirement attached to the threat of expulsion was made stricter. A cartel was created by three contractors and they all delivered offers of around five times the authority budget. The authority repeated the tender, which meant additional costs of 350, leaving them with only 850, and let Contractor 4 participate. The main changes made in the invitation to tender were setting a maximum price of 1,700 and lowering the minimum condition of sections one to three to two stars.

Contractor 2 won the tender and performed seven Heavy Actions, which though far-reaching, were not enough to achieve the requirements. The contractor was fined 1,200 and went bankrupt.

Fourth round

Environmental aspects ceased to be taken into account. The penalty for non-compliance was halved. Contractor 1 performed no Actions on the road network, bringing the network condition down dramatically from 2.2 to 0.8. He had to pay a sanction of 750, but since he received a payment of 1,000 and had no costs, he made a profit of 250 out of 1,000.

The case of the Dutch procurement professionals

This game involved four contractors, two of which had a competitive advantage. The players were six professionals in innovative contracting, who worked for ministries, road authorities, contractors, consultants and research institutes.

First round

With a budget of 1,200, the only selection criterion was price. The contractor with the second cheapest nominal value won, since the lowest offer was conditional on risks above 100 not being covered by the contractor. The requirements were a two-star rating during the contract period and a three-star rating in year four. The penalty for non-compliance was 100 per section and a bonus of 50 per section rated above four stars during the contract period was offered. Contractor 2 performed three Heavy and three Light Actions, which was enough for most sections. He received a bonus of 350 and a sanction of 100, making a profit of 300 out of 875.

Second round

No changes were made to the rules. Contractor 1 won with the lowest offer. With a work plan of five Heavy and one Light Action, he delivered a network condition above the required levels. He received a bonus of 450 and made a profit of 285 out of 700.

Third round

The selection formula was changed, with the aim of minimum inconvenience to traffic. Besides the nominal price, contractors had to deliver the number of actions they planned to perform; each additional intervention meant a price disadvantage of 50. Contractor 2 won with a price far below the rest and the second lowest number of actions. With a work plan of four Heavy Actions, he delivered a condition which met precisely the required levels and above four stars during the contract period. He consequently received a bonus of 450 and made a profit of 200 out of 390 (bid nominal value). He also benefited from a positive event: oil prices went down, lowering the cost of maintenance actions for all contractors. He had to pay 640 to the bank for his maintenance plan, instead of 700.

Fourth round

Under the same rules, Contractor 4 won this round. His offer was not the lowest. He won because Contractor 1, who had recently merged with Contractor 3, offered an equal price but did not deliver a work plan and was disqualified, while Contractor 2 offered a slightly lower price but proposed two more actions. The winner performed only three Light Actions, not enough to ensure the minimum road condition required. Nevertheless, he delivered condition above 4 stars in years two and three for section four. He received a bonus of 100 and a sanction of 600, making a loss of 490 out of 295.

The case of the Dutch maintenance professionals

There were three contractors with equal resources and cost structure. The subjects in the different roles were five professionals, members of the Dutch Maintenance Society (NVDO) and asset management experts working for public and private organizations like the Railways Authority (ProRail), the port of Rotterdam Authority, provincial water companies, and specialized consulting firms.

First round

With a budget of 1,300, the only selection criterion was price. Contractor 1 won with the lowest price. The authority requirements were a condition of two stars during the contract period and a final condition of four stars. No sanctions were associated with poor performance, but rather with the availability of the network. Depending on the number of actions performed, a contractor would receive a bonus of 5 to 10% of the value of the contract, or a penalty of 5% if more than three actions were performed in a road section during the contract period, increasing by 5% per additional action.

Contractor 1 performed three Heavy and two Light Actions, which resulted in lower condition levels than required for four sections. Since no penalties were associated with poor performance, the contractor suffered no direct economic consequences. However, based on his poor performance the authority refused to pay him the 10% availability bonus he was entitled to. He complained and threatened to bring the case to court. The other contractors supported the decision of the authority. He nevertheless filed his complaint. He made no profit.

Second round

Important changes were made to authority rules. With a budget of 1,000, final condition requirements were lowered from four stars to three, and a penalty for non-performance was set at 20% the value of the contract. The availability sanction was also set at 20%. Additionally, a key change was made to selection criteria. Contractors were required to submit a detailed work plan together with their price. Its effect on the network condition would be assessed on the basis of an annual degradation of

0.4. Contractors would be awarded a price advantage of 50 per 0.1 point of average network condition. This formula resulted in the selection of Contractor 3, with the highest price and average condition. He performed seven Heavy and two Light Actions and delivered quality far above the requirements. He received an availability bonus of 5% and made a profit of 170 out of 1,425. He only made a profit due to the availability bonus and a positive event that granted him 100. The price offered was equal to the total cost of his work plan.

Meanwhile, the case of Contractor 1 was discretely solved by a higher authority with a compensation of 50.

Third round

Equal selection criteria were used, except that the maximum desired quality was set at 4.5. As for the requirements, minimum condition levels were increased to three during and four at the end of the contract period. The winner was again Contractor 3, this time with the lowest price. He performed five Heavy Actions delivering a final condition above the levels required and earning an availability bonus of 10%. He made a profit of 90 out of 875.

Fourth round

A budget of 800 was granted. The same rules were kept, except that the availability bonus was halved. Contractor 1 won. He performed three Heavy Actions - two actions less than promised - and delivered insufficient quality for two sections, even though he benefited from an event that lowered the degradation rate of section three in all years. He received an availability bonus of 30 and a sanction of 120, making a loss of 15 out of 600.

6.7.2 Changes in players' strategies: Analysis of incentives given by road authority and response of contractors

Before the analysis of each of the cases is presented, it is important to introduce a classification of the contractors' strategies. Based on their offers (including the work plan and corresponding total upgrading points and profit), the degree of consistency between the information they delivered with their offer and their private information, and finally, on the performance they delivered, players can be classified as cooperator or defectors. This categorization is used by evolutionary theorists (Axelrod and Hamilton 1981), game theorists (Gintis 2000) and behavioural economists (Henrich et al. 2001, Fehr et al. 2002). It defines three main types of player: unconditional cooperators, unconditional defectors and tit-for-tatters, who cooperate with cooperators but defect with the defectors. The difference in this case is that, defection or cooperation is not necessarily between equivalent players - other contractors - but also towards an arbitrator or road authority.

An account of the regulatory changes made and evidence of learning by road authority and contractors during the games will be given here.

The case of the Spanish students

Since none of the additional selection criteria - except for price - determined the results, the changes implemented during the different rounds will not be discussed. Tables 6.6 and 6.7 summarize the continuous development of the rules in this case.

In the first round, levels of trust decreased and doubts about the fairness of the authority were raised. Poor selection together with the loss made by Contractor 3 sent two messages to the private sector: it does not pay off to be a quality-oriented contractor; nor does it pay off to be a cooperator. In the second round, a similar message was given out. Poor selection occurred, with Contractor 4 offering the lowest value for money, and very poor performance was delivered. Nevertheless the winner, clearly a defector, made a profit of 300.

Later, in round three, the authority dramatically increased the penalties, in combination with already low trust levels. This made the sector feel threatened and justified in protecting itself by creating a cartel. Cartel prices distorted the idea of prices and costs - of the authority and of contractor four - and resulted in lower condition requirements in the new tender. The authority was forced to soften the rules. However, instead of lowering penalties, they lowered requirements, set a maximum price, and forgave Contractor 4. The economic result was catastrophic for the winning contractor, which followed a cooperative strategy. Again, as in round one, the wrong message was sent out; the idea that being a cooperator does not pay off was reinforced.

In round four, the authority finally learned the lesson and penalties were reduced accordingly. However, this was rather late, by then levels of trust were so low that this reduction, in combination with very poor selection, resulted in exactly the same outcome as in round two.

The case of the Dutch procurement professionals

Both the rules and the strategies used by contractors were more stable and less volatile in this case (see Tables 6.8 and 6.9). During the first three rounds, the authority was consistently able to select the best (or second best) offer. The authority only lost control in the last round. Consequently a less detailed account of the changes will be sufficient and this analysis will focus on the contractors' strategies.

Contractor 2 succeeded because he adapted to the system quickly. He was the first to discount bonuses from the price offered, while the rest continued to calculate in the conventional way - total costs plus profit. He only failed to win round two because Contractor 1, using the same strategy, had a significant competitive advantage. However, Contractor 2 did not invest in R&D.

Table 6.6: *Development of incentives in the Spanish case, part A*

DEVELOPMENT OF GAME RULES																																	
	Round 1					**Round 2**					**Round 3A**					**Round 3B**					**Round 4**				
Selection criteria	Criteria	Weight		Det		Criteria	Weight		Det		Criteria	Weight		Det		Criteria	Weight		Det		Criteria	Weight		Det	
	Price lowest	1		Yes		Price lowest			Yes		Price lowest			Yes		Price lowest	Maximun 1700		Yes		Price lowest	Maximun 1700		Yes	
						Environmental Stars	100 price advantage per star		No		Environmental Stars	100 price advantage per star		No		Environmental Stars	100 price advantage per star		No						
											Historical Performance (HP)	100 price advantage per point		No		Historical Performance (HP)	100 price advantage per point		No		Historical Performance (HP)	100 price advantage per point		No	
Offers received		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4
	Price	775	1225	725	1000	Price	1050	1000	1100	800	Price	5250	6100	6000	No offer	Price	1630	1275	1300	2500	Price	1000	No offer	1500	1300
	Env*	Nap				Env*	1	0	0	0	Env*	No information submitted			No offer	Env*	1	0	0	1	Env*	1	No offer	0	1
	HP	Nap				HP	Nap				HP	No information submitted			No offer	HP	+ 100	0	- 100	0	HP	+ 100	No offer	- 100	0
Additional Information per offer	WP	9	8	8	12	WP	11	6	11	0	WP	22	22	22	No offer	WP	14	14	13	25	WP	0	No offer	16	11
	Profit	-6%	41%	0%	-5%	Profit	5%	48%	9%	100%	Profit	64%	68%	68%	No offer	Profit	25%	4%	10%	11%	Profit	100%	No offer	5%	25%
Price determinant	Yes					Yes					Nap					Yes					Yes				
Requirements	Used	Min	Amount			Used	Min	Amount			Used	Min	Amount			Used	Min	Amount			Used	Min	Amount		
Penalty	Yes	3	100 per section(end)			Yes	3	100 per section(end) & threat of expulsion			Yes	3	300 per section(end) & threat of expulsion			Yes	2	300 per section(end) & threat of expulsion			Yes	3	150 per section(end) & threat of expulsion		
Bonus	Yes	4	50 per section(end)			No					No					No					No				
Monitoring	No					No					No					No					No				
Network Condition	Target	Required	Delivered			Target	Required	Delivered			Target	Required	Delivered			Target	Required	Delivered			Target	Required	Delivered		
	3.4	3	2.8			3.2	3	0.8			3.4	3.4	0.8			2.8	2.8	2.2			3.4	3.4	0.8		
Financial results	Budget	Saved	Winner C			Budget	Saved	Winner C			Budget	Saved	Winner C			Budget	Saved	Winner C			Budget	Saved	Winner C		
	1000	225	-150			1000	200	300			1200					850	-425	-1150			1000	0	250		

Table 6.7: *Development of incentives in the Spanish case, part B*

ECONOMIC INCENTIVES			
Round	**Winner**	**Winner Strategy**	**Total Profit**
1	3	**Cooperator** (more or less, but had to pay too high price for minor miscalculations)	-150
2	4	**Defector** (no actions carried out and 100% profit)	300
3a	None	**Defectors** (Cartel - 3 contractors united asking for near 70% profit)	Nap
3b	2	**Cooperator** (relatively good work plan and low profit level, brought condition to higher levels)	-1150
4	1	**Defector** (no actions carried out and 100% profit)	250
End	**1 different each time**	**3 out of 4 times - defectors**	**-12%**

Contractor		C1	C2	C3	C4
Resources	Initial	200	200	200	200
	Final	250	-1000	-50	350
R&D cards		**3 cards:** 1 E* 1 LA&HA(-5) 1 (?)	**1 card:** No results	**1 card:** No results	**2 cards:** 1 E* 1 no results

Meanwhile Contractor 3 failed to adapt, continued to calculate the price offered in the traditional way and therefore continued to lose. Nevertheless, his initial competitive advantage and investment in R&D enabled him to merge with Contractor 1 once approaching bankruptcy, a choice Contractor 4 did not have. Contractor 4 succeeded in adapting to the new bonus system but probably grew disappointed after unsuccessfully trying different strategies, and facing bankruptcy, chose to become a defector.

Defection happened only once, in round 4. However, due to the sanctions and significant loss made by this contractor, the message was given out to the sector that being a defector does not pay off.

The case of the Dutch maintenance professionals

The rate of change in the rules in this experiment was somewhere between the other two cases: the rules of the authorities and contractors strategies were less volatile than in the Spanish case but not as stable as in the DPP experiment.

In the first round, with price as the only selection criterion, all the offers received resulted in approximately the same profit but were based on very different work plans.

Selection was relatively good; Contractor 1, who read the invitation to offer the best, discovered that there were no economic penalties for non-performing and that there was a relative gap since bonuses were only associated to availability. His smart

Table 6.8: *Development incentives in the Dutch Procurement Professionals (DPP) case, part A*

DEVELOPMENT OF GAME RULES																				
	Round 1					**Round 2**					**Round 3**					**Round 4**				
Selection criteria	Criteria		Weight		Det	Criteria		Weight		Det	Criteria		Weight		Det	Criteria		Weight		Det
	Price lowest		1		Yes	Price lowest		1		Yes	Price lowest		1		Yes	Price lowest		1		No
											Number of actions/min		50 price disadvantage per action		No	Number of actions/min		50 price disadvantage per action		Yes
Offers received		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4
	Price	640	875	1049	775*	Price	700	725	995	700	Price	640	390	640	525	Price	295	285	Merged 1	295
	No. of actions	Nap				No. of actions	Nap				No. of actions	5	4	5	3	No. of actions	Not spec	5		3
Additional Information per offer	WP	12	9	10.6	8	WP	11	10	11.4	10	WP	9	8	8	6	WP	11	10		12
	Profit	20%	6%	17%	6%	Profit	-24%	-24%	14%	-14%	Profit	-11%	-79%	6%	0%	Profit	-120%	-181%		3%
Price determinant	Yes*					Yes					Yes					No				
Requirements	Used	Min	Amount			Used	Min	Amount			Used	Min	Amount			Used	Min	Amount		
Penalty	Yes	3 (end) 2(during)	100 per section (end & during)			Yes	3 (end) 2(during)	100 per section (end & during)			Yes	3 (end) 2(during)	100 per section (end & during)			Yes	3 (end) 2(during)	100 per section (end & during)		
Bonus	Yes	4	50 per section (during)			Yes	4	50 per section (during)			Yes	4	50 per section (during)			Yes	4	50 per section (during)		
Monitoring	No					Yes					Yes					Yes				
Network Condition	Target	Required	Delivered			Target	Required	Delivered			Target	Required	Delivered			Target	Required	Delivered		
	3	3	3.0			3	3	3.2			3	3	3.0			3	3	2.0		
Financial results	Budget	Saved	Winner C			Budget	Saved	Winner C			Budget	Saved	Winner C			Budget	Saved	Winner C		
	1200	-25	300			1200	-30	285			1200	270	200.00			960	545	-490		

Table 6.9: *Development incentives in the Dutch Procurement Professionals (DPP) case, part B*

ECONOMIC INCENTIVES			
Round	**Winner**	**Winner Strategy**	**Total Profit**
1	2	**Cooperator** (little profit and good work plan-prob. Counting with bonuses)	300
2	1	**Cooperator** (counting with bonuses -cheap but did increase the quality of road)	285
3	2	**Cooperator** (counting with bonus -coop- WP only slightly less than the one of C1, but very low price and profit -below price to recover with bonuses- Smart WP! -no sanction and 9 bonuses)	200
4	4	**Defector**	-490
End	**C2 won 2 out of 4**	**3 out of 4 times - cooperators**	**-10%**

Contractor		C1	C2	C3	C4
Resources	Initial	600	200	200	200
	Final	535	600	Merged 1	-540
R&D cards		**5 cards:** 2 no results 1 E* 1 HA(-5) **& from C3:** 1 LA&HA(-10)	No card bought		**2 cards:** 2 no results

behaviour ensured that he was selected but did not pay off and he made no profit (see Tables 6.10 and 6.11). Additionally in this round, the authority received the support of the rest of contractors in its decision not to pay the availability bonus. This created a positive atmosphere from the beginning and established trust between authority and contractors.

The authority learned that ambiguity in the rules results in legal battles. They tried to prevent opportunistic behaviour by adding a work plan as part of the selection criterion and requirements; closing the gap between target conditions and penalized levels. The additional criterion proved effective in preventing contractors from cheating. It also resulted in high quality offers, two of them already discounting bonuses from their prices.

The new formula resulted in the selection of Contractor 3, with the highest price and average conditions. The winning contractor read the tendering rules better, more "literally" and reacted faster than the rest. He offered an ambitious work plan that would bring average quality up to 4.6, while the other two limited themselves to 4 and 3.2 assuming that the authority would not have budget to pay such a plan. The selection of the most expensive and highest quality work plan resulted in a final average network condition of one point above the needed, but also in financial problems for the road

authority.

The authority, learning from their experience with Contractor 3, set a maximum desired quality of 4.5. By then contractors had already learned to use the rules and probably started to understand that the authority could not find out whether they were performing the work plan delivered with their offer or not. So the offers resulted, surprisingly enough, all in the same end condition. The offer representing the highest value for money was selected, which resulted in an end condition above required levels.

The authority, probably believing they were in control under the rules they had been using until then, kept these unchanged and, only partly because of being forced by the lower budget they received, halved the availability bonus. This time two of the three contractors delivered a different work plan than the one they had prepared internally and even Contractor 3 did not seem to count anymore on bonus as a promising source of profit. Not surprisingly, poor selection took place. Contractor 1 won and drove quality downwards, but not as dramatically as in the Spanish case. Since he made a loss, the message that to be a defector does not pay off was sent to the sector, again.

6.7.3 Comparison of performance delivered

An overview of the performance achieved in each of the experiments is presented in Tables 6.12 and 6.13. This performance is the result of the interplay between formal rules and contractors' strategies. These indicators provide a first impression of what the consequences might be of the new contracts on the road network condition, the financial performance of the authority and contractors and on the development of the market, depending on the effectiveness of the policy measures implemented by the authority.

The success of the road authority was significantly higher in the DMP and DPP cases than in the Spanish case. The DMP authority, in particular, succeeded in applying other selection criteria than price, while the DPP authority managed to implement a smart combination of bonuses, sanctions and random monitoring that resulted in a new pricing strategy for contractors and promoted cooperation. The Spanish authority, on the other hand, failed in consecutive rounds to prevent opportunistic behaviour and to establish a positive atmosphere of trust.

Higher condition levels were achieved in the DMP case. Road condition was maintained well and continued to increase until round four. However, the DMP authority performed less well financially than the DPP authority. They borrowed from the bank more than the equivalent to 45% of their budget versus 5% recorded in the DPP experiment. Both authorities made efficient use of funds, obtaining the best value for their money in three out of four rounds.

In the creation of a competitive market, the most effective authority was again the one from the DMP game. The highest profit level achieved by a contractor was 12%, even

Table 6.10: *Development of incentives in the Dutch Maintenance Professionals (DMP) case, part A*

DEVELOPMENT OF GAME RULES																				
	Round 1				**Round 2**				**Round 3**				**Round 4**			
Selection criteria	Criteria	Weight	Det		Criteria	Weight	Det		Criteria	Weight	Det		Criteria	Weight	Det	
	Price lowest	1	Yes		Price lowest		Yes		Price lowest		Yes		Price lowest		Yes	
					Average Network Condition Promised (ANCP) based on WP	50 price advantage per 0.1 higher network condition (Deg: 0.4)	Yes		Average Network Condition Promised (ANCP) based on WP	50 price advantage per 0.1 higher network condition (Deg: 0.4)	No: All equal		Average Network Condition Promised (ANCP) based on WP	50 price advantage per 0.1 higher network condition (Deg: 0.4)	No: All equal	
									(+) Maximum proposed quality: 0.5 above target of 4				(+) Maximum proposed quality 0.5 above target of 4			
Offers received		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3
	Price	750	1075	1150	Price	900	1150	1425	Price	950	975	875	Price	600	675	750
	ANCP[a]	Nap			ANCP	3.2	4	4.6	ANCP	4.8	4.8	4.8	ANCP	4.6	4.6	4.6
Additional Information per offer	WP	8	11	13	WP	9	13	16	WP	8*	10	10	WP	6*	8	7*
	Profit	3%	9%	0%	Profit	11%	0%	0%	Profit	24%	10%	0%	Profit	13%	-7%	17%
Price determinant	Yes				No: the most expensive				Yes				Yes			
Requirements	Used	Min	Amount		Used	Min	Amount		Used	Min	Amount		Used	Min	Amount	
Penalty (cond)	No	4* (end) 2 (during)			Yes	3 (end) 2 (during)	20% of contract value		Yes	4 (end) 3 (during)	20% of contract value		Yes	4 (end) 3 (during)	20% of contract value	
Penalty (actions)	Yes	Max 3	5% per road section per whole period. Increasing 5% per time above this limit		Yes	Max 3	20% per road section per whole period.		Yes	Max 3	20% per road section per whole period.		Yes	Max 3	20% per road section per whole period.	
Bonus (actions)	Yes	Max 1	10%		Yes	Max 1	10%		Yes	Max 1	10%		Yes	Max 1	5%	
		Max 2	5%			Max 2	5%			Max 2	5%			Max 2	2.5%	
Monitoring	No				No				No				No			
Network Condition	Target	Required	Delivered		Target	Required	Delivered		Target	Required	Delivered		Target	Required	Delivered	
	3.8	Not specified	2.8		3	3	4.0		4	4	4.2		3.8	3.8	3.8	
Financial results	Budget	Saved	Winner C		Budget	Saved	Winner C		Budget	Saved	Winner C		Budget	Saved	Winner C	
	1300	550	0		1000	-495	170		1000	35	90.00		800	170	-15	

[a] ANCP = Average Network Condition Promised, based on Work Plan delivered with bid

Table 6.11: *Development of incentives in the Dutch Maintenance Professionals (DMP) case, part B*

ECONOMIC INCENTIVES			
Round	**Winner**	**Winner Strategy**	**Total Profit**
1	1	**Partly defector** (only fulfilled the conditions for which there was an economic incentive! - not the "targets")	0
2	3	**Cooperator** (more or less, but kind of "opport" in a certain way)	170
3	3	**Cooperator** (more or less, but kind of "opport" in a certain way)	90
4	1	**Defector** (lied in the WP promised, and did not reach the targets!)	-15
End	**C1 and C3 won all the tenders. No tender was won by C2**	**2 out of 4 times - cooperators**	**5%**

Contractor		C1	C2	C3
Resources	Initial	200	200	200
	Final	85	-50	360
R&D cards		**1 card:** No results	**1 card:** E*	No card bought

including bonuses. Although only two contractors remained at the end, as in the other two experiments, their final results were more balanced than in other game sessions - differences between contractors were not that large. Nevertheless, they did not succeed in promoting as much investment in R&D as the other two authorities. These investments were particularly fruitful in the DPP experiment, where the efficiency of one contractor increased significantly. Furthermore, the highest levels of trust and the most positive contracting atmosphere were achieved by the DPP authority. The satisfaction of contractors seems to earn them the title of most professional client.

6.7.4 Lessons learned from each game

From the Spanish case, it can be learned that extremely high penalties have negative effects. They either result in collusive behaviour or in faster market concentration as they lead contractors to bankruptcy.

There are three main findings from the DPP case. Firstly, a smart combination of significant bonuses and moderate penalties, together with monitoring may result in higher levels of trust, the creation of a positive atmosphere and a proactive and a cooperative attitude on the part of contractors. Secondly, the case illustrates the risk that almost bankrupt contractors pose to the stability of the system. Thirdly, the case also illustrates how the contractor who is fastest to adapt, able to read the instructions

Table 6.12: *Overall performance on different games, part A*

Performance Indicators	Spanish Experiment	DPP Experiment	DMP Experiment
Determinant Selection Criteria	- Price determinant in all 4 rounds - Other criterion proved not effective	- Price determinant in first 3 rounds - Number of actions was decisive in last round	- Price determinant in 3 rounds, except round 2 - Promised quality, based on work plan delivered was decisive in second round, the most expensive offer was selected
Contract Incentives	- Bonus only used in first round and extremely penalties since 3rd round resulted in - Perverse incentives; defectors made profit, while cooperators were hardly sanctioned and made losses - Contractors with best financial situation at the end are defectors - Low levels of trust	- Combination of attractive bonuses and moderate sanctions was kept constant in all rounds - Incentives proved effective to promote cooperative behavior. The only defector -in round three and mainly led by his bad financial situation- made significant loss - Contractor with best financial situation was the most cooperative	- Combination of availability bonus sanction and average condition related sanctions was kept constant from round 2 on - Incentives proved effective to promote cooperative behavior. The defector -in round one and four- made losses in accordance to degree of defection - Contractor with best financial situation was the most cooperative
Monitoring	- Never used	- Used always from round 2 on	- Never used
Authority Financial Performance	- Inefficient use of funds: received twice no value for money; only once they selected the best offer - More than 300 were lost in extra transaction costs (repetition of third tendering round) - Money saved in the first 2 rounds was at the expense of road condition, and - The same quantity, 425, was borrowed in round 3 to bring condition back to usable levels	- Efficient use of funds: three times got the highest value for money and not once no value for their money - Borrowed in first two rounds but less than 5% their total budget - Saved in two rounds, an only last round at the expense of road quality	- Efficient use of funds: three times got the highest value for money and not once no value for their money - Only 50 were lost in extra transaction costs - Had to borrow more than 45% their budget in second round - Saved in all other three rounds
Network Condition	- Out of control - Fell twice below usable levels - Never returned to initial levels	- Kept under control above desired levels, except in last round - Never fell below usable levels (2 stars) - Twice higher than initial levels	- Kept under control; significantly above desired levels, except in first round - Never fell below good condition (3 stars) - Three times much higher than initial levels

Table 6.13: *Overall performance on different games, part B*

Performance Indicators	Spanish Experiment	DPP Experiment	DMP Experiment
Sector Financial Performance	- Short term: per round minimum (-)90% maximum 40% - Long term: average profit of -12%	- Short term: per round minimum (-)160% maximum 50% (including bonuses and sanctions) - Long term: average profit of -10%	- Short term: per round minimum (-)2.5% maximum 10% - Long term: average profit of 5%
Sector Innovation	- Total investments in R&D: 350 (7 cards) - Results: Only one contractor became cheaper (5 MU in both light and heavy actions), and 2 were certified as environmentally responsible - High investments in R&D but with poor results	- Total investments in R&D: 350 (7 cards) - Results: one contractor -mergence contractor 1 and 3- became quite cheaper (10 MU in Light Actions and 15 in Heavy Actions) and certified as environmentally responsible - High investments -sector did become more efficient	- Total investments in R&D: 100 (2 cards) - Results: one contractor certified as environmentally responsible - Poor investments in R&D and no significant gain in efficiency
Sector Satisfaction	- One tender had to be repeated - Negative atmosphere: does not pay off to cooperate	- No tender had to be repeated and no complaint filed - Positive atmosphere: to cooperate does pay off; contractors assumed a proactive attitude, discounting bonus from their prices	- One complaint was filed by a single contractor, while other contractors supported the authority - Positive atmosphere: to cooperate does pay off
Market Development	- Only 2 contractors -the defectors- remain - Significant differences between contractors: highest debt is 1000	- Only 2 contractors -the cooperators- remain - Significant differences between contractors : highest debt is 540 - Marked differences in cost structures (partly due to initial competitive advantages and R&D investment policies)	- 2 contractors of 3 remain -one cooperator and one defector - Small differences in resources between contractors: highest debt is 50 - No differences in cost structures

most closely and able to calculate precisely the economic consequences of his work plan and the risks he takes, is more likely to become the winner.

Finally, the DMP case exemplifies a sharp road authority. They adapted their rules in reaction to opportunistic behaviour, but most of the time they did so intelligently, doing only what was necessary. For example, in round one poor performance did not result in the elimination of the bonus, as it did in the Spanish case, but in the introduction of a work plan as selection criteria. Penalties were set at a reasonable level and economic sanctions were in line with the degree of defection.

The work plan as a selection criterion was effective in preventing cheating, but the effectiveness of this measure was 100% only in the first round. Afterwards it continued to decrease, probably due to the lack of a monitoring policy.

In fact, their mistake was that they paid a considerable amount of money for more quality than was needed. In round two, Contractor 3 benefited from double compensation, more work and a higher price. It would have been better to use a formula that calculated value for money.

6.7.5 Main differences and similarities recorded

Remarkable differences are recorded throughout the development of rules and contractors strategies in these three cases. These differences may show the existence of different institutional (or cultural) settings and how these result in different equilibriums being achieved. Each institutional setting represent a unique combination of a population with a high or low propensity to defect, and a particular interaction structure characterized by the absence or presence of punishment opportunities.

Spanish contractors were faster to react and had more volatile strategies. Already in the first round -when bonus was promised- three of four contractors offered a price below their costs. Meanwhile it took more than one round to (Dutch) contractors in the DPP session to react to the same incentive. In a similar way - the contractors of the DMP session reacted to the new selection criteria (that valued quality) relatively slowly. Only contractor 3 did adapt and that ensured him success for two consecutive rounds.

Common patterns in contractors' strategies were also recorded, mostly between the DPP and DMP experiment. Contractor 2 in the DMP experiment followed a similar strategy as contractor 3 in the DPP case. They were both good intentioned but not sharp and fast enough in adapting and consequently both never got selected. On the contrary, contractor 3 (DMP) and contractor 2 (DPP), were faster to adapt and sharp in reading "precisely and literally" the terms of the invitation to tender; and succeeded more often than the rest in being selected.

Throughout all the experiments it was evident how contractors learned to play with the rules and find weak spots within the whole set of laws. As a result, policies became less effective after a certain period.

6.8 Patterns observed across all sessions

In this section a list of common findings -patterns observed across the full set of experiments- will be presented. These observations support the findings from the detailed analysis of the three most illustrative cases presented in the previous sections.

An analysis of these fourteen sessions raises concerns about the effects of these innovative practices. In all the experiments, a process of market concentration was observed; road authorities seldom succeeded in keeping the condition of the roads under control or effectively implementing other selection criteria than price, and contractors' opportunistic behaviour played a very substantial role during the tendering process.

Nevertheless, some agencies were more creative than others in creating incentives for contractor cooperation and investment in research and development. All in all, it was observed that while high penalties create incentives for collusive behaviour, a combination of moderate penalties with significant bonuses proved effective in making contractors pursue more cooperative and proactive strategies.

Some contractors proved more successful than others. Depending on the incentives introduced by road agencies, the best approach was in general not to cooperate or defect, but to read the invitation to tender literally and find weak points in it. Finally, there was evidence that the financial situation of contractors had a strong impact on their strategy: they made riskier choices as their financial resources dwindled.

6.9 Reflection

At a methodological level, the results indicate that policy analysts and practitioners interested in anticipating the consequences of new contracting practices may indeed benefit from the use of gaming techniques or experimental methods. The gaming exercise proposed has proven particularly helpful in examining the issue of opportunistic behaviour.

From the analysis of the simulation results, it appears that opportunistic behaviour plays a very substantial role during the tendering and implementation process of road maintenance reform. The role of the road authority, and especially its anticipation of contractor behaviour, its subtlety in administering specifications, and its incentives for "good" and "bad" behaviour on the part of contractors are key in averting anomalies and a decline in road quality. Many agencies, but not all, seemed to fail in this important mission.

There are also findings with direct implications for procurement policy. Firstly, high penalties seem to create incentives for collusive behaviour, while a combination of moderate penalties with significant bonuses creates a positive atmosphere of trust. Secondly, monitoring is of key importance when effectively implementing any system of sanctions and bonuses, as it increases the expectations of contractors about the reward and punishment choices of the road authority. In other words it increases their

belief in the rules of the authority. Thirdly, it proved difficult to establish a stable set of rules and to obtain exactly the results intended, as policies become less effective after being applied for a certain period. Lastly, in all game-runs a process of market concentration was observed.

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Chapter 7

Conclusions and reflection

7.1 Introduction

The research has resulted in the development of a lesson-drawing framework, which combines two elements. First, a comparative dynamic framework that serves as a guide for countries to evaluate if successful elements from practices elsewhere can be incorporated in their own regulatory regimes, contractual arrangements and practices. Second, a generic gaming-simulation tool that allows policy makers to experiment with different contract settings and incentives so as to arrive at the understanding needed to set the right incentives for contracts within their national institutional context.

The findings and evidence collected through the combined use of both these instruments are discussed in this chapter. The lessons drawn are integrated to present a reflection that, in addition to answering the main research question, aims at presenting an overview of the opportunities and challenges posed by innovative contracting practices and drafting a research agenda for the future based on the contributions of this study.

7.2 Conclusions

Four trends are identified in road procurement practices: integrated project delivery methods combining different phases of the life cycle of the road; use of higher level indicators in contracts so as to grant contractors more design space; long term contracts; and projects privately financed. While these innovative forms of contracting are expected to provide the road sector with more flexibility, more innovation, higher performance and lower costs without putting public values at a disadvantage, previous empirical evidence suggests that they increase the room for opportunistic contractor behaviour, thus endangering the safeguarding of public values.

For the purpose of this study, the problem confronting national road infrastructure administrators and many other administrators of network-bound infrastructures was formulated as a trade-off: *How to achieve the positive results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (on the part of contractors) and its (negative) effects at the minimum possible?*

This research project aimed at supporting policy makers around the world in providing an answer to this question. A number of factors need to be understood, such as: how to ensure that innovative contracts incorporate proper incentives that deal with the risk of opportunistic behaviour, which effects have these contracting schemes brought so far in practice, is innovation taking place, and how to implement these practices at full scale and succeed in the creation of a competitive market. The main findings will be presented in this section, along these thematic lines.

7.2.1 Dealing with opportunistic behaviour

The first formal analysis of innovative contracting practices indicated that the implementation of these practices indeed results in greater scope for opportunistic behaviour. Innovative contractual arrangements implemented to increase flexibility and design freedom of contractors worsen the problem of information asymmetry, as contractors hold more private information that is not available to the road authority. These arrangements may also lead to market concentration, as larger scale contracts are being tendered. The resulting extra scope, if exploited by contractors, translates into quality decline and poses a threat to the fulfilment of public values in the long term. This tension between technical aspects of flexibility - operationalized as design space granted to contractors - and public values was clearly captured in the system diagrams presented in Chapter 3: increasing flexibility does have an impact on the room for strategic behaviour (Altamirano and Herder 2006).

The evaluation of practical experiences of three countries and experimental results showed that the problems of information asymmetry and market concentration do play an important role in innovative contracting practices. The evidence gathered corroborated the tension between the technical aspects of design freedom and the fulfilment of public values:

Information asymmetry

As game sessions advanced, the road administration appeared to lose touch with how much a certain level of service costs, which shows that information asymmetry between principals and agents only increases over time. This finding raises concerns about the ability of road agencies to control contractors in this new system.

The problem of information asymmetry was also recorded in the case studies. Road authorities lack the necessary historical and statistical information about the total costs of keeping certain assets at a certain level of performance, or so-called total

costs of ownership (TCO), even at today's prices. This problem is only expected to increase as contractors take care of these assets for longer terms.

Market concentration

Potential market concentration is one of three common challenges that require further attention in the three countries researched. It is a main concern expressed by different market players in the road sector -especially smaller and medium sized contractors- and also by public officials. A relevant question is whether savings due to economies of scope and scale -brought by these practices- will soon be reversed as contractors will get more market power and may be forced by low profit levels to start acting defensively. During all game sessions significant fluctuations in profit levels and a process of market concentration were observed[1].

Substantial role of opportunistic behaviour

Game results demonstrated that there is cause for concern about granting greater freedom to contractors. A decrease in the condition of the network was recorded in a considerable number of sessions. The role of the road authority, and especially its anticipation of contractor behaviour and its subtlety in administering specifications, as well as incentives for "good" and "bad" behaviour on the part of contractors, turned out to be crucial in averting anomalies and a decline in road quality. Many agencies in the various game runs failed in this important mission.

From the analysis of the fourteen sessions it was clear that opportunistic behaviour plays a very substantial role during the tendering process.

Even though contractors often started out with similar cost structures, the market moved quickly towards an imbalance, with a few players holding strong competitive advantage. Participants with experience in the sector, recognized these market dynamics as a real and serious consequence of the new large-scale integrated contracts.

Not only opportunistic behaviour as such plays a substantial role in these new contracting practices, but the concrete shapes it takes also differ from those seen in traditional situations described by principal-agency theory. These differences will be described in further detail in the following Section 7.4.4.

The formal analysis of contracts based on agency theory and engineering design theory presented in Chapter 3, leads to the conclusion that innovative contractual arrangements in fact belong under the category of "neoclassical contracts", or hybrid

[1] It is important to clarify that a limitation of the game simulation developed is indeed that entry of new companies is not possible. However, this is an assumption not far from reality for asphalt businesses because of the large number of government and other permissions needed to open a new (hot mix) asphalt plant (which require air pollution permits). Apart from legal requirements, there are other requirements related to the nature of the material. Asphalt plants must be located (strategically) fairly close to road construction sites. Paving is difficult at lower temperatures, and highway contractors will reject asphalt that is not hot enough (at least 250 degrees).

types of coordination mechanisms, rather than under the "classical contracts". Therefore, they cannot be expected to be complete and self-enforcing and their success depends on the enforcement mechanisms implemented by the authority and the way uncertainty is dealt with.

Interesting enforcement mechanisms being applied by national authorities and concrete ways in which they are dealing with opportunistic behaviour were discovered through the case study research. Before presenting these, however, it is important to explain that the changes brought into the national road administration system by the introduction of some of them often pose new problems or dilemmas. Those issues need further consideration if the plan is to implement these practices full scale in the future.

First, a common method used to control contractors, while granting them relatively more freedom, is the so-called "own responsibility principle". This means that contractors have to submit, together with their offers, a Quality Control Plan. They themselves realize the monitoring of the different performance indicators and keep their accountability, on the basis of which they prepare periodic reports for the road authority. At the same time, consultants (Quality Control Consultants) are hired by the road authority to check if contractors are following the plans and procedures promised through random checks and auditing. The higher penalty or deduction is often the one due to non-compliance with their own Quality Control Plan. This solution however does not solve the problem of information asymmetry, especially concerning long-term maintenance, and results in an increased dependency on external engineering consultants.

The significant increase recorded in the number of external consultants working for the road authority in a variety of roles and tasks poses a new trade-off of *efficiency versus integrity*, which will be explained in the following section.

Second, the use of economic incentives and disincentives, bonuses to promote "good behaviour" and penalties to deter contractors from "bad behaviour", is being implemented more and more by national road authorities. These instruments have proved to be effective especially in achieving shorter project delivery times and increasing contractor awareness of user wishes. Nevertheless, finding an adequate balance of positive and negative rewards has proved difficult in practice.

An additional challenge for the successful implementation of these and other enforcement mechanisms - and for any good proven rules of the game in general - is posed by the fact that rules lose their effect over time. Selection criteria, requirements and incentive schemes work best the first time they are applied and lose their edge in consecutive tendering rounds. This is a pattern observed in different countries and in all gaming sessions. As will be discussed more elaborately under Section 7.4.1 *-Stability of rules-*, the low stability of rules is either a consequence of opportunistic behaviour or changes in external factors.

Although the task of building the right incentives and enforcement mechanisms

Table 7.1: *Game simulation findings*

Game simulation findings with direct implications for procurement policy
(1) High penalties create incentives for collusive behaviour.
(2) A combination of moderate penalties and significant bonuses proved effective in making contractors pursue more cooperative and proactive strategies and in creating a positive atmosphere of trust.
(3) Monitoring is of key importance if implementing any system of sanctions and bonuses is to be effective, as it increases the expectations of contractors about the reward and punishment choices of the road authority. In other words, it increases their trust in the rules of the authority. Monitoring does not have to take place constantly, or in all road sections, but it has to be clearly present. An option would therefore be the application of random checks, as carried out nowadays by road authorities.

in a contract is indeed quite challenging and not at all straightforward, the analysis of the different game sessions provides findings with direct implications for procurement policy. These are presented in Table 7.1.

7.2.2 The use of innovative contracting practices

The gains expected to be achieved from innovative contracting arrangements are: more flexibility in the road sector, more innovation, and higher performance and consequently lower costs, while keeping up service levels on public values. But are these expectations realistic given the higher risk posed by opportunistic behaviour of contractors? Have national road authorities indeed succeeded in implementing these practices. How advanced are they in their use and which gains do they record? Which effects can be anticipated -through simulation- from the further reform and full scale implementation of these practices? Answers to these questions will be discussed briefly in this section.

The experiences of the Dutch, Spanish and Finnish road authorities have been analysed to estimate their relative advance in the use of innovative contracting practices and the outcomes they have recorded (in terms of "improvements" in efficiency and innovation or degree to which their own expectations have been fulfilled). The main findings from this analysis indicate the following.

- The relative advance in the use of innovative contracting practices in the market of capital projects is significant. DB and/or other integrated project delivery methods represent more than 40% of the projects being tendered or have even become the norm. This advance is also significant in the area of routine maintenance through the use of service area agreements.
- Nevertheless, the contracts used in periodic maintenance remain rather traditional and consequently the reform of this sector remains a challenge for all

three countries.

- The implementation of innovative contracting arrangements has not directly resulted in larger design space or freedom granted to contractors. It has been observed that design freedom remains limited even in the most innovative projects per country.
- Although no unambiguous measures of "improvement" are available -as information about performance, total life cycle costs of assets, etc. was not gathered in the old public infrastructure management system-, and the improvements that are recorded per country are often specified in terms of own national priorities, innovative project delivery methods have proved effective in shortening project delivery times, and the service area agreements implemented for routine maintenance have resulted in savings of around 30% in the Netherlands and Finland.
- However, based on the complaints of contractors about current profit levels, the danger of cut-throat competition recognized by certain road authorities and the expected and observed process of market concentration, there is a serious concern about whether the savings recorded are only temporal and may be reversed in the future.

In order to explore the effects of innovative contracting practices in the performance of the road system in the medium and long term, fourteen game sessions were played. An analysis of the sessions raised concerns about the long-term effects of innovative contracting practices. In all the experiments, a process of market concentration was observed as well as significant fluctuations in profit levels of the sector. Besides, road authorities seldom succeeded in:

- Keeping the condition of the roads under control. If they considered it profitable to do so, contractors would abuse the decision power and freedom granted and let the network degrade to levels that threatened its functionality. A decrease in condition - at least temporarily- and even below minimum levels has been recorded in a significant number of sessions.
- Keeping road condition and finances under control. In those cases where the road condition was kept always at minimum levels and even higher, this always happened to the detriment of public finance and requiring the granting of additional budget to road authorities.
- Effectively implementing selection criteria other than price. Promoting innovation and investment in research and development (R&D). Often contractors were not very enthusiastic about investing in R&D and they did not sustain their investments after experiencing a single card with no results. This observation also fits the general conservative and risk-averse attitude of the private contracting sector towards risks associated with investments in R&D and implementation of new technologies.

All in all, the task of the road authority proved an extremely complex one. The road authority has to carry out a balancing act between, on the one hand, the short-term and direct effects of rules that prevent opportunistic behaviour and ensure required service levels, and, on the other hand, the long-term indirect effects of these rules on the financial health and professional development of the private sector.

7.2.3 Design freedom and innovation

One of the goals often cited for the implementation of innovative contracts is the promotion of technological innovation in the sector, by increasing the flexibility and design space granted to contractors. Therefore, the analysis of this aspect deserves special attention.

One of the first findings derives from the system analysis presented in Chapter 3. In order to achieve innovation, policies that increase flexibility and design space for contractors need to be implemented in combination with policies that reduce the risk contractors take by investing in new technologies. In other words, it is not enough to provide contractors with design space or decision power with regard to technologies and methods to be used. In addition, the duration of contracts should also be long enough to provide them with the security needed to invest in new technologies. Or alternatively payment mechanisms or other economic incentives built in the contract should make the case for investment in new technologies. The need for this combination of factors was confirmed by contractors active in the different road markets in the countries researched.

The empirical findings are alarming. Even though road authorities often claim that one of the main goals of the changes in contracting arrangements was to increase the design freedom for contractors and therefore create more room for innovation, the process of transferring the control of design decisions to contractors has been slow, especially where bridges are concerned. Some of the reasons behind this slow advance are:

- Organizational resistance to change.
- Learning curve as the implementation of functional instead of technical specifications requires a different type of expertise from personnel of both the authority and the contractors.
- Lack of historical information on total life cycle costs (both sides).
- The comparability of offers required by public obligation of ensuring transparent awarding procedures. Offers need to be comparable to prove real competition, but this also means that contractors are still being judged on the prices for the main solution, and not so much on how innovative their alternative solutions are.

Apart from these obstacles, the patterns of information-sharing observed in innovative projects signal the presence of a constant tension or trade-off between (design) freedom granted to contractors and risk distribution or risk transfer. This tension is at the heart of the government responsibility of safeguarding public values.

The fact is that design freedom remains limited even in the most innovative projects implemented up to date. In all countries observed there are formal and regulatory obstacles for granting more design space to contractors. Besides, there are informal institutions, like the attitude towards the management of uncertainty and dealing with change requests from contractors that play a role in limiting this space, especially in Northern Europe. The design freedom granted and the flexibility that results from this kind of innovative contracts appears to be even more limited in Finland and the Netherlands, than in Spain. This may partly be due to the fact that traffic risks (i.e. market or demand related risk assumed by concessionaires when projects are financed through direct tolls) are not placed on the private participant in the application of availability-based payment formulas but absorbed by the public client. This is often the case in Northern European countries.

As can be observed, a number of obstacles need to be overcome if innovation is to be achieved. The question is, even when greater design freedom is granted -as it is the case in certain projects where all life cycle phases are integrated- can it result in (fundamental) technological innovation? Or just in process related innovations? This question will be discussed in Section 7.4.3, *Viability of technological innovation*.

Improvements on design freedom granted, given the limitation posed by the obligation of comparability offers that hold in standard public tendering procedures, may be achieved by implementing in certain cases alternative tendering procedures such as unsolicited proposals and competitive dialogues. These alternative tendering procedures allow private companies to compete on the basis of how innovative their ideas are, and not only on the basis of price. The latest Dutch PPP project (Second Coentunnel) applied competitive dialogue with success.

Before moving on to the next topic, it should be mentioned that measuring or quantifying design freedom or design space has proved challenging. This is a limitation of the research framework adopted. In order to more accurately judge the magnitude of design space granted and to compare whether this is larger in one country than in another, an additional set of concepts and proxies needs to be adopted.

7.2.4 Lessons from other countries

From the study of the road sector reform implemented in three pioneer countries and their relative performance, it has been found that the institutional starting positions of various countries can differ so markedly that they are bound neither to follow the same developmental paths nor to produce similar institutional outcomes after the reform. By comparing the initial and final institutional structures, reviewing the preferences of the

actors before and after the reform, and comparing the particular reform paths they followed, it became evident that Finnish, Spanish and Dutch actors have selectively taken ideas from the worldwide pool of ideas on road reform. Their initial circumstances kept them from adopting all ideas from the worldwide agenda, at least with the same emphasis. Instead, these countries have each chosen the reform ideas most suitable to their situation. This selection process has resulted in a new institutional equilibrium in which a particular subset of ideas, for each of the countries, has been absorbed.

These findings confirm Rose's hypothesis that there is a multiplicity of factors that influence the outcome of a lesson-drawing process or determine the feasibility and probability of practices from place A being (successfully) transferred to place B. These factors will be discussed in the following section.

All in all, the evidence reveals limits to the transferability of lessons. However, despite differences in institutional contexts and historical developments, learning from another country is still possible. What remains unattainable is the formulation of ready-made recipes or best practices that are applicable to a wide range of countries, independent of individual goals or priorities. There are no lessons to be drawn about the specific choices or mix of contracting practices applied by these three different countries, but much can be learned from the coherence of choices made with their own policy priorities. Inspiration and lessons can be found in the way they have managed the reform processes, whatever the specific form they opted for. Thus inspiration can be found in the Spanish case from the way in which they succeeded in creating enough deal flow (i.e. pool of similar projects or stream of opportunities to tender as a collective whole) for PPP projects that offset the high transaction costs involved. Finland is a good example of strong (internal) agency leadership and effective management of stakeholders, which led them to achieve consensus up-front and to stick to the original implementation plan (as discussed with stakeholders), even in the face of external pressures.

From the three countries studied, Finland and Spain were found more successful than the Netherlands in their implementation of road reform and innovative contracting practices. A combination of external factors and leadership styles in both countries was crucial to create the necessary sense of urgency needed to implement radical reform of the sector.

7.3 Transferability of lessons

It could be claimed that Finland typically represents a successful example of the liberalization in which direction a number of countries in Northern Europe are headed, whereas Spain can be seen as a forward-looking representative of the Latin model, in which the aspect of privatization comes more to the fore. The way the reform was implemented, as well as the relative progress each of them has shown in the use of

innovative contracting, provide evidence that even though both countries have taken up the challenge of road reform, they have done so in very different ways. Surprisingly enough, both countries have become world examples and pioneers in their own right. Both can be pleased with the extent to which they have realized their objectives, within the context of their own national system.

But which exactly are the factors that influenced them to select different options from the worldwide agenda on road reform? The analysis of the different reform paths of these countries and the dynamic comparative framework developed has increased the understanding of what circumstances and to what extent contracting practices or procurement models effective in country or city A or B will work in country or city C. As Rose points out, the critical task in lesson-drawing is to identify the contingencies that affect whether a programme can be transferred from one place or time to another (Rose 1993, 118). Such contingencies are factors of the local agenda, which include external factors, initial conditions and historical and cultural circumstances. Contingencies that proved influential in the choices taken by the different countries in the context of road reform are:

(1) The presence of a financial crisis (external factors) in combination with the relative condition and extension or degree of development of the national road network proved influential on the choice for either a more commercial approach to management of roads or an adequate and stable supply of funds to the road sector, as main goal of the reform.

(2) The political perception of an oversized road authority (initial conditions) - which depends not only on the absolute number of employees but also on the types of tasks they are performing (e.g. whether they still have personnel realizing maintenance works), the strategic role of the road network and the perceived importance of the task assigned to the road authority- proved influential not only on the selection of a preferred restructuring option but also proved to be a powerful drive on the choice for prioritizing implementation of integrated contracts.

(3) Existing expertise and markets (initial conditions), and to a certain extent past positive or negative experiences with certain procurement models (historical circumstances), proved influential on the priorities and preferences assigned to the implementation of either of the trends in innovative contracting.

(4) Cultural circumstances such as the focus on certain public values or national development strategy (i.e. emphasis on efficiency and transparency in Northern European countries versus a Southern European policy of national and/or local champions) proved influential on the choice for second level goals (more autonomous and accountable management and better staff incentives, versus promoting the introduction of the users pays principle). In more general terms, they proved crucial for the prioritizing of liberalization over privatization .

(5) National leadership styles or political systems, i.e. strong leadership and majoritarian electoral systems versus consensus oriented states (historical and cultural circumstances), in combination with the relative sense of urgency experienced, have an influence on how comprehensive -radical and stable for a long period of time - the reform implemented is.

For the detection of such contingencies for a particular policy area and the design of a viable programme to be implemented in a particular country or city based in the example of others, Rose (2005) proposes a set of 10 steps. An alternative would be to apply a similar approach to the one developed for this research project. Differences between the study realized and the prescribed steps in lesson-drawing as proposed by Rose are twofold. First, the analysis does not follow (rigorously) the last three steps proposed by Rose (2005) and continue all the way to design a complete new programme for a receiver country. Instead, the choice has been made to develop a gaming-simulation tool that facilitates learning and lesson-drawing about the problem for different problem owners of diverse national backgrounds. Second, as a result of this choice for a tool, the findings of the research overcome the main weakness of lesson-drawing as described by De Jong (2009). De Jong's main criticism is that the generic policy models proposed by Rose should be made devoid of context, such as leadership style, cultural and historical background, after which they can be re-contextualized as a "lesson" for the new environment they will be transferred to. This problem is avoided by allowing the players of the gaming-simulation to bring their own institutional and cultural background into the game, which is already a form or re-contextualization.

7.4 New challenges and dilemmas

Based on the empirical findings summarized in the previous section, a number of issues that deserve further discussion and research have been formulated. These issues represent new challenges and dilemmas faced by road authorities within the new public procurement paradigm and require further examination if innovative contracting practices are to be implemented on a larger scale.

7.4.1 Stability of rules

On the basis of national experiences and game findings, it has proved challenging to formulate rules (i.e. selection criteria, requirements and incentives) which are effective in deterring contractors from opportunistic behaviour and encouraging them to cooperate with road authorities.

The task of road authorities becomes even more complex once effective rules have been discovered, because these become less effective after having been applied for a

certain number of tendering rounds. A number of mechanisms are at play that challenge the stability of these rules. First, opportunistic behaviour of contractors who almost immediately -or after first time of application- discover the weaknesses or gaps in the new system of rules. Second, interdependence between contractors' strategies. This can occur once all contractors have fully understood the economic consequences of new rules and have adapted their strategy accordingly. The strategy followed by the winner of the first application round of these rules then becomes less effective and the results achieved by these rules so far are challenged. Contractors that consequently won initially may have been acting cooperatively and may now be forced to adapt a somewhat different strategy to win the next contract.

The decreasing effectiveness of rules is not only to be blamed on opportunistic contractor behaviour. Often rules lose effectiveness as the authority in order to save money reformulates them and takes their edge off. In fact, the root of the problem or the difficulty to keep a set, of rules stable, especially in the case of bonuses and their effectiveness in obtaining the expected cooperative behaviour, lies in the conduct of both sides. Both principal and agent aim at maximizing their own gains, test the limits of the new incentive system and end up implementing or provoking changes that take the edge off the new set of rules.

Contractors, aiming at maximizing profit, are fast to adapt to new rules, read them literally, find weak spots within the system and use them to their benefit. In the case of bonus, for example, they are fast to react with tenders and work plans that allow them to earn the maximum bonus. In their turn, road authorities, aiming at maximizing savings for the public interest, also often tend to reformulate and lower the magnitude of bonuses, if after being implemented a first time, they do turn out effective in delivering the desired outcome but also result in significant profit for the private company. Especially influential is the public perception about how high these private earnings are. Two examples from practice follow.

The first PPP project implemented in Finland (Järvenpää-Lahti motorway) offered an incentive for early delivery to private contractors that resulted in the project being finished a year ahead of time. For the second and most recent PPP project (E18 Muurla-Lohja motorway) the bonus was lowered in magnitude to such an extent that it was no longer attractive for the winning consortium to accelerate the construction process. In a similar fashion, the Dutch road authority changed the type of payment scheme applied to privately financed projects from shadow toll to availability fees, after the first two tunnel projects delivered under a shadow toll scheme in the late eighties had resulted in earnings for the winning consortia perceived as too high by public opinion.

In maintaining the effectiveness of certain rules or enforcement mechanisms- especially requirements and penalties- for a somewhat longer period of time, monitoring has proved useful in practice as well as during gaming sessions.

7.4.2 Efficiency versus integrity

Two common patterns observed in the countries studied are an increasing use of consultancy and engineering firms (CE firms) by national road authorities and an increasing use of integrated project delivery methods -like Design-Build- that promote the cooperation between CE firms and construction companies and even the establishment of long-term alliances. The first trend results from the combination of a drive to downsize public agencies and the implementation of new enforcement mechanisms like the "own responsibility principle" that relies on CE firms to conduct the necessary auditing and monitoring of contractors processes and/or performance. The second development aims at increasing innovation, shortening project delivery terms and reducing total life cycle costs (LCC) of infrastructure assets.

These two processes seem to point in somewhat contradictory directions and to "pull" CE firms in two different directions and place them in the midst of new moral dilemmas. This poses a trade-off for authorities which is better formulated as efficiency versus integrity.

To better understand the roots of this new dilemma, here is a summary of traditional versus new project delivery methods. In a traditional project delivery method, such as Design-Bid-Build (DBB), each phase of the realization of a structure is broken into a sequence of smaller projects or work packages. The roles of client, contractor and CE firm are transparent and separated; the different responsibilities are clearly described and well covered by the institutional bodies such as laws, rules, regulations and institutes (Antoine 2002). The road authority fulfils the role of project manager and has the authority and technical competence to give a go/no go for each of the project phases. Due to the prescribed sequence of events and regulations, transparency is ensured. But the process as a whole is rather time consuming. Thus a drawback of this method is its low efficiency.

By using innovative project delivery methods such as Design-Build-Maintain (DBM), three life cycle phases are integrated into one contract. Therefore the winning consortium requires the teaming up of a CE firm, a construction company and a maintenance contractor. The added value delivered by this cooperation of skills and expertise lies in the minimization of total life cycle costs (LCC) by integrating the phases and thus allowing the consideration alternative solutions early in the design phase. A more sustainable design and better quality materials may be used, even if they require higher up-front investments, if this leads to significant savings in maintenance costs - which represent around 80% of total costs of ownership-, minimizing LCC. An additional efficiency gain from this type of delivery method is often a reduction of transaction costs -as only one tendering process takes place instead of three-, while reduced bureaucratic processes result in projects being delivered within shorter times than under the traditional DBB method.

In short, the efficiency of these innovative contracts is higher, but the moral dilemmas change. Competitive advantages of CE firms include not only technical expertise but

also high moral standards. Working as a consultant for the road authority, the CE firm has an obligation to the client; the client itself will make the final decisions. Working as partner of the winner consortium, the CE firm has a performance obligation to the alliance and is co-responsible for the decisions made within the alliance.

Traditionally CE firms have acted as advisors of public authorities, but the recent developments in contracting require them to act as partners of private contractors while at the same time acting as a "watch dog" for the public authority, which takes them into compromising territory.

On the bright side, the advantage of having CE firms working in different roles and in cooperation with contractors may be in the accumulation of knowledge of all stages of the works resulting in a better overall quality, as practical and academic experiences are integrated. However, this cooperation with contractors may compromise the integrity of the CE firm and its loyalty towards the road authority, especially when it fulfils the roles of auditors and quality monitoring bodies.

The uncertainty introduced by long-term contracts in combination with the tendency observed within road authorities to reduce the size of their technical (civil engineering) departments (losing in-house technical expertise) poses a number of questions for the management of these contracts. The study of concrete innovative PPP projects and their management in Finland, Spain and the Netherlands showed that even though a number of strategies are applied for the control of opportunistic behaviour and the mitigation of information asymmetry, strategies to combat information asymmetry related to (production) costs in the future are missing. Road administrations do not have in place benchmarks with other sectors or (national) road administration bodies that allow for a dynamic comparison of construction and maintenance costs in the future. Meanwhile, comparison of costs with projects and service contracts in other countries does not seem plausible, given the technical nature of roads -climate and ground characteristics are very influential on minimum construction requirements and on deterioration rates-. Therefore as time passes, road authorities lose their in-house technical expertise and governments lose their access to independent experts in leading technologies, a number of questions arise:

- Will technical hand-back requirements of facilities be valid in 20 or more years? If new technologies, techniques or road standards are developed that change road maintenance, how will a proper dialogue take place to adjust these requirements with a road authority that does not have at its disposal the personnel that has followed these developments and is capable of understanding them?
- If service fees have to be renegotiated (because main materials become more expensive or new requirements concerning service levels are in place), how capable will the road agency be to arrive at a new "fair" price?

All in all, this new situation requires further research not just about the possible gains in efficiency, but mainly about the risks or strategic threats road authorities may face

in the future if these two trends (i.e. increasing use of CE firms and increasing co-operation between CE firms and contractors) are continued. Previous research about the integrity of possible roles of CE firms in PPP projects has been carried out by Antoine (2002) and others. However, in this study, as often in public discussions about this issue, the probability and gravity of such conflicts of interests are minimized by citing formal barriers and other procedures that are part of the codes of conduct of associations of CE firms:

> If the CE firm acts in the role of advisor for a public body in the planning phase of a project, the firm is excluded to act as partner or advisor in the alliance who wants to tender for the execution of works, as this could lead to information benefits in favour of the tendering alliance (Antoine 2002, 8).

This argument overlooks the fact that these barriers are temporal. The belief that they may entirely remove the risks of conflict of interests (in the present and the future) underestimates the importance of informal flows of information and communication as well as the effect that long-term partnerships between CE firms and certain contractors have in the loyalty of CE firms. The probability and risks of such conflict of interests are expected only to increase if both practices -integrated project delivery contracts and monitoring by CE firms- are implemented at large, since contractors will become an equally important market for the services of CE firms as public road authorities used to be.

Research is urgent before these trends unfold to prevent the road authority -continuously downsizing- from finding itself totally dependent on CE firms and unable to revert the changes brought about by integrated project delivery methods as well as unable to properly safeguard public values.

The reaction of consultants to this new environment could be explored by making use of experimental methods such as gaming-simulation. In fact, during the conceptual design of Road Roles, the role of consultants and the effect of possible opportunistic behaviour on their part were considered. In the end it had to be decided to leave them aside in order to simplify the gaming exercise. Given the modular way in which the game has been developed, however, the role of consultants could be added without major extra effort.

7.4.3 Viability of technological innovation

Even though the design space granted to contractors remains rather limited, a new kind of innovation is taking place as contractors and consultants are learning to work together on the integrated delivery of a project. An example is provided in an interview with a Senior Consultant of the CE firm teaming-up in the winning consortium for the latest PPP (E18 Muurla-Lohja motorway) in Finland (3 April 2006):

> Now we (consultants) try to work differently. Traditionally, the designer worked alone and only once he had finished its task, could the construction contractor start working on the project. Now we try to work together. In the new E-18 project we have an example of the innovation, that it can be possible thanks to this cooperation. It concerns the lighting of the project. In this case we first calculated an overall figure (e.g. quantity of light posts); then the contractor selected a supplier; and subsequently we continued working on the final design of the system together with this supplier in order to find the optimal distance between light posts. The solution attained will generate important life cycle savings because the total costs of lighting the tunnels is equal to construction costs plus energy costs over many years!

This new type of innovation has a positive effect on the performance of the road system, as it often results in savings of total life cycle costs (LCC) of an infrastructure or in more efficient work processes and methods. Nevertheless, a compelling question arising from the empirical evidence gathered in the countries studied is: how fundamental are these innovations? And are innovative project delivery methods -such as DB and DBFM- the best way to deliver technological innovation? Or should alternative ways be found?

The main objective reason to doubt whether PPP or any other integrated project delivery method that shifts all financial risks to contractors is effective in delivering innovation, is the known fact among project managers that the most risky phase of a PPP project is the construction phase. Accordingly, private contractors would always opt for 100% proven technologies, especially under such contracting schemes where they bear the financial and operational risks of the project for the next 15, 20 years or more.

In the old system, where projects were procured using a DBB model, the government invested directly in research and development activities by sponsoring research in road agencies and/or universities. Nowadays it is expected that private companies make these investments themselves in order to be more competitive. The government expects the market to take the lead and find new solutions. But is this realistic under the current system of incentives and circumstances? Among other aspects:

(1) Preference for proven technologies during project delivery.

(2) Low profit levels and/or important fluctuations in profit levels in the road sector, and the threat of cut-throat competition.

(3) Limited design space granted in practice to contractors and even more limited design freedom passed down from main contractors to subcontractors.

Investments during the old procurement system were more focused on fundamental research than they are at present. In Finland, for example, topics which used to be prioritized were traffic, landscaping, noise and geotechnics. This research conducted by the Finnish Road Administration (Finnra), the Technical Research Centre of Finland (VTT) and Finnish universities, ensured a huge technological development in stabilizing techniques -pertaining to geotechnics- from which the whole construction sector in Finland derived profit.

Nowadays the focus is on cost-effectiveness. Innovations have to be cost effective in order to be developed further and eventually implemented. The planning term therefore also seems shorter. In fact, no more fundamental innovation seems to be taking place. What is mostly happening is that companies "innovate" in a country by bringing in the technologies or expertise they have built somewhere else. The innovations that do take place are "process" innovations rather than real technical or technological innovations.

The future does not seem bright. Alternative mechanisms need to be found if fundamental and technological innovation is desired. The government may need to support or promote research and development within companies by making use of subsidies or forging long term alliances. Successful cases of such strategic alliances resulting in significant technological progress can be found in the petrochemical industry.

7.4.4 New trends in opportunistic behaviour

The implementation of the new lump-sum performance-based contracts or long term service agreement, brought a change in the formal relationship between road agency and contractors (principal and agent) as it involves fulfilling new roles. Moreover, the study of particular innovative PPP projects in the three countries studied indicates that the problem faced by road authorities is no longer as simple as often described by agency theory. Within these new contracting schemes, plausible opportunistic behaviour from a contractor (agent) is not simply a matter of investing less effort in the work than is expected by the principal. The new problem no longer seems to be about delivering low or bad quality, since requirements and indicators monitored, and on which payment is conditional, are more output or outcome oriented. Instead, the question is whether the road authority is able to negotiate or is paying the "right" or "fair" price for the quality or level of service that has been established in advance (and for the set of risks transferred to the contractor). As contracting is more than ever about proper "risk distribution" and "risk sharing", the principal is left more at a disadvantage. Not only during the realization or implementation of the work, as agency theory emphasizes, but also ex-ante, before the project has actually started. We are no longer looking at a negotiation about production costs and profit margins, but at a set of risks and estimates of how much each of these risks is worth.

In other words, if contractors take advantage of the principal, this may happen prior to

the closing of a contract, during the negotiation phase about the distribution of risks. Large multi-national companies and concessionaires that have participated in other PPP projects around the world can often afford more experienced legal experts and negotiators than government agencies can. As a result, they might arrive at a risk distribution favourable to them, with the public authority bearing most of the risks, or paying far too much to the contractor for accepting these risks. The general picture becomes blurred and it is far more difficult to determine what a fair price is. Negotiation is about risks and not purely about material or engineering aspects. Determining a fair price was definitely far easier in the past, when projects and technical solutions were calculated in terms of cubic meters of asphalt. In agency theory terms one could say that there has been a shift in importance from moral hazard to adverse selection.

It is important to highlight that in this new situation it is also difficult for contractors themselves to assign a price to certain risks and levels of reliability. A question posed by practitioners -particularly in the Netherlands where contractors perceived that too high risks are transferred and/or too high system availability levels are required- is to what extent the principal is paying for a service or placing an incentive for better performance, and to what extent he is actually paying insurance. Some of these risks may be better placed and negotiated in a different market- such as the insurance market- as contractors themselves may not (yet) be able to actually control these risks. The government may be better off assuming some of these risks directly and/or requiring somewhat lower levels of system availability.

Alternatively, government authorities with a history of payments of too high prices to contractors often react by tendering similar contracts for considerably lower budgets in the future. Here a new problem emerges. Contractors, urged to avoid the high costs of idle capacity, may accept to take part in the tendering even when it is clear to them that profit margins are slim or they may actually make a loss. This endangers the development of the sector. Or they may submit offers even below their costs, hoping to recover the losses in the future either through renegotiation or by engaging in legal claims. It has been observed in all game sessions that in this new system the most successful contractors are those who adapt faster and read precisely and literally the new terms of the invitation to tender (i.e. deducing future bonus from their price and/or anticipating gains they may extract by exploiting the weak spots of the contract). Meanwhile, the less successful are the ones that stick to calculating their bids based on the traditional way based on total costs plus profit margin. In practice smaller contractors tend to be the ones having more difficulty to adapt to the new ways of calculating prices for their offers.

The truth is that either way, whether the authority or the contractor is the looser of the game, both deals are suboptimal from a societal point of view because either quasi-monopoly rents are paid from taxpayers' money, or the future of the private sector is put in danger, while often unproductive legal costs must be born by both parties.

The role of the authority as a guardian of public values and public finances is nowa-

days more challenging than ever. In the new contracting setting versus the traditional one, opportunistic contractor behaviour plays a larger part not only prior to contract closing but also afterwards, as these new contracts leave ample space for future contract renegotiations or legal battles.

Innovative contracts by their very nature are bound to remain incomplete, thus increasing the possibility of, or the need for, renegotiations of contract terms in the future and requiring a different set of strategies to mitigate opportunistic behaviour. Three major differences between traditional and innovative contracts that explain the root of this new problem are:

(1) New contracts use a different incentive scheme (Laffont and Tirole 1993). Traditional contracts were often (quasi) cost-plus-fixed-fee or cost-plus contracts; contractors were paid in unit prices and project managers within authorities could easily estimate the profit margins of companies submitting a tender. Thus contractors hardly bore any risk. This is considered a very low-powered incentive scheme. Innovative contracts are often fixed-price contracts or so-called lump-sum contracts, under which the winning firm is residual claimant for its cost savings. The road authority does not de facto reimburse any of the costs; it pays only a fixed fee; the contractor runs almost all project risks. This is considered an extremely high-powered scheme.

(2) The item being contracted is no longer a physical "product" or delivery of a physical asset or facility, but a "service" and moreover, the availability of such service for an x number of years. The task of ensuring service availability implies that the responsible contractor acquires additional risks, apart from construction related risks. He is now the one that has to deal with a number of uncertain external factors. (These may vary from sudden failure of a system subcomponent to changes in prices of raw materials or fluctuations in traffic levels.)

(3) Contract terms of this new type of contracts are often longer, from 3 or 5 to up to 30 years or more. This exponentially increases the number and range of risks assumed by the private contractor, as well as the number of unexpected reasons for a renegotiation of the contract.

All three points above only mean a significantly higher amount of risks being transferred to the private sector, for which a fair price has to be negotiated up-front. Innovative contracts also mark the beginning of a new attitude or way of managing contractors at a distance, which means that public authorities in their role of clients have less possibilities and authority to influence the process or steer contractors directly in a particular preferred direction. Thus again, many more aspects need to be decided up-front than in traditional contracts.

To summarize, road authorities in their new role of quality regulators, or at most network operators, have to find new ways of dealing with new types of opportunistic

behaviour, while accepting the possible costs of initial failures as part of the learning process towards a new equilibrium. But patience and acceptance of failures as necessary investment are not enough to ensure success. Significant savings in time and money could be achieved if proper investments in training of personnel at all levels -procurement directors, contract managers and engineers formulating requirements- were realized and effort invested in anticipating the weaknesses of future contracts and their formulation.

Further research and development of training tools that support public authorities in the successful implementation and management of innovative contracts and their dynamics are urgently required to prevent public values being compromised and society paying far too much as part of the learning process.

Gaming and other simulation techniques offer a great opportunity in this respect, as they allow practitioners to learn from their mistakes without carrying the costs of real-life failures. The first step towards success is to create understanding across the whole organization that these new procurement practices require a very different attitude and set of skills; and an awareness of public servants and contractors that they are dealing or about to deal with problems of a different and more dynamic nature. Road Roles proved to be an effective eye-opener for participants.

7.5 Outlook and further research

First of all, on a theoretical level; this research and the pragmatic approach adopted for the formulation of the dynamic and comparative conceptual framework -which include notions and assumptions from different economic theories- make an important (conceptual) contribution to the analysis of national contracting practices and comparable research problems where institutions at different levels need to be taken into account. There is a common perception that these economic perspectives are in conflict with each other, probably originating from the fact that (some of) their application areas have been ill defined. The complementary use of these theories proposed here contributes to a better understanding and delineation of their areas of application, but definitely more research is needed on this issue.

The tools and findings of this research have opened new paths for further research in the area of innovative contracting. They are in fact applicable to all infrastructure sectors or infrastructure managers -public and private- experimenting with new ways of procuring and managing their portfolio of assets and projects. The following are examples of such pathways. Some of them are part of research proposals already under consideration that will probably result in further extensions of the game simulation Road Roles and deal with its current limitations. Others are concrete recommendations for future applications.

7.5.1 Reform in road maintenance

As previously stated, contracting for periodic maintenance remains rather traditional and consequently the reform of this market remains a challenge for all three countries studied. If the quantitative magnitude of periodic maintenance contracts versus few new capital projects is considered, as well as the large influence such maintenance activities have on the condition of the network; the choice for researching the impact of innovative contracts precisely in this area of periodic maintenance, seems inevitable.

This research project -through gaming-simulation- has contributed to the research of the medium and long-term consequences of these innovative contracts in periodic maintenance for the network condition and the performance of the road sector in general. It has also provided insight in how road agencies could prevent or control the possible negative effects of opportunistic behaviour in these new contracts. Experimental findings corroborate that the response of contractors to greater freedom and the consequences of their choices in the physical condition of the network are issues to be concerned about, since a decrease in the condition of the network was recorded in many sessions.

As many European road authorities -besides the three researched- are seriously discussing the future implementation of Performance Based Service Agreements that combine both Routine and Periodic Maintenance, the subject needs to be investigated further. Especially since -as observed- in this kind of integrated contract the consequences of poor contractor performance could certainly threaten the functionality of the road network. The following excerpt from the project plan of the research project "Performance Based Service Agreements (PBSA) in Routine and Periodic Maintenance" from ERA-NET Road[2] confirms the urgent need for such research:

> The European NRA's (National Road Administrations) are in different stages of service contracting. Most of the countries have been analysing new contract forms and there is a need for trans-national discussion. The NRA's gathered to the Copenhagen workshop on 10 Oct 2007 considered that a common analysis of the contents and terminology would be useful to start with. Service contracting requires different competencies compared to traditional contracting, and those requirements may give unexpected market effects. The possible vision is: Open markets on EU level in routine and periodic maintenance of roads (Project Plan of PBSA, ERA-NET Road, Final version 14.2.2008/ Markku Tervo (Finnra), p.1).

[2]ERA-NET Road is a commitment by eleven National Road Administrations to work in partnership to develop joint research programmes financed through joint funds. Between them they already manage research programmes with a combined annual budget of around €150M. ERA-NET ROAD will also assist National Road Administrations without research programmes to develop them and implement research in a manner that contributes to European integration. It brings about a joint vision and research programme, with joint targets, funds and calls for research. See `http://www.eranetroad.org/`

Table 7.2: *Assumptions and limitations of Road Roles*

(1) A single pool of contractors of rather homogeneous nature was assumed. Given the technical particularities of periodic versus routine maintenance and the different strategic assets, competitive advantages and work conditions these different tasks pose on companies personnel, they often represent two very distinct markets and often register different levels of market concentration. In order to anticipate more accurately the consequences of merging both activities in a single contract for the process of market concentration, it may be advisable to model separately both pools of market players.
(2) A single (public) client has been assumed. Given the importance of installed capacity in the construction sector, the inclusion of more public clients offering different types of contracts and incentive schemes, could improve the accuracy of the results in terms of the magnitude of market concentration and market power that could be exerted by companies in case their need to win a contract is lower than when having a single client.
(3) Road Roles has opted for a general degradation algorithm or network condition model to realize the impact analysis. This was necessary for it to be a tool to be used by people from different countries. If the model is to be adopted as planning tool within a particular country, the network condition model may be modified to include the dynamics proper of the local ground and pavements types normally used, which may influence the degradation rates as well as the magnitude of maintenance costs.

The future integration of routine and periodic maintenance activities in one contract may prove more complex than expected since there are important technical barriers - different technologies and skills- and since it may result in a further process of market concentration, leaving too few competitors able to perform well in such contracts. Given the purpose of this research, the practical challenge of integrating both tasks has been somewhat simplified in the gaming-simulation Road Roles. Three assumptions that may pose restrictions to the application of Road Roles for the further research of this problem are presented in Table 7.2.

Some of the questions commonly posed by the ERA-NET road research project and closely related with the issues researched through Road Roles and/or issues for which further research has been advised are:

Incentive schemes: What is needed for a shift to a collaborative approach? Which payment mechanisms and performance requirements may be helpful to achieve cooperation and a positive atmosphere in the sector?

Enforcement and quality monitoring mechanisms: Type of performance requirements to be applied and performance descriptions? Quality control in service agreements? How can new technologies -ICT and other high-tech methods- contribute to monitoring and quality control? What type of information and minimum historical data are needed for the drafting of a proper service agreement?

Roles and responsibilities of different groups of professionals/actors: Contractors and consultants know-how: how to get them inside? Existing ways to operate in main-

tenance? Current and future situation of contractors and consultants and contractors-consultant relationship? What will be the role of different actors, sub-contractors or partners?

Market effects: Which different markets will play a role? How will competition evolve? Which rules of the game should be set? Volume of contracts used nowadays? Is partnering, networking or the creation of long-term alliances desirable and/or viable? What are the current market volumes and market competition levels?

Innovation: How can (more) innovations take place? How can future innovation be included in agreements and how to promote such innovations.

7.5.2 Dynamic contracting in infrastructure projects

It is evident that a new set of skills is required for a successful implementation of innovative contracts; in the road sector as well as in all other infrastructure sectors experimenting with them. A new approach that takes account of the dynamic nature of this environment and the impossibility of writing complete contracts is required.

Road authorities need to realize that drafting complete and totally self-enforcing contracts for integrated project delivery methods that combine design and construction tasks with long-term performance-based service agreements is just not possible. During the life time of such contracts, the environment of the contract changes, information about relevant external factors is updated, and even client needs and therefore contract goals will change. It is impossible to specify the legal consequences of every possible state of the world. The complexity of drafting and executing a proper tender procedure is enlarged not only by the uncertainty brought by the long-time horizon and the nature of the transaction contracted, but also by higher transaction costs of observing, monitoring and agreeing on contractors' performance versus traditional direct supervision methods. Equally challenging for contractors is to estimate the (economic) outcome of a contract in such a dynamic, uncertain, and sometimes very competitive environment without having access to all relevant (future) information. The uncertainty and information-asymmetry that both players are confronted with when participating in the tendering of infrastructure projects, often lead to sub-optimal deals both for asset owners (often authorities) and service providers (contractors).

In order to maximize the gains of both parties by minimizing cost overruns, avoiding delays, and increasing social benefits, research questions that need to be explored regarding tendering with incomplete information in a dynamic setting are the following. How can public authorities in their role of asset managers and network operators be supported in setting up the rules for tendering? How can contractors be supported in participating in a tendering process?

Alternative methods for drafting and managing these new contracts could be devel-

oped by studying the problem from the perspective of mechanisms design[3] in combination with the application of gaming-simulation tools.

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[3]Mechanism design is a theory on designing methods to arrive at good contracts and therefore more desirable outcomes by providing incentives to all involved to disclose more relevant information than is presently the case. See the work of Van der Krogt et al. (2008).

Appendix A

Relationship between notions of conceptual framework and research strategy

Table A.1: *Relationship between notions of conceptual framework and research strategy*

Unit of analysis	Theory applied	Role of the theory
Innovative Contracts (general)	Agency theory & Design engineering	Chapter 3: Theoretical or formal analysis of the new types of contracts leading to problem diagnosis
Innovative contracts: a particular PPP project (embedded unit of case study protocol)	NIE	Chapter 4: project related questions Typology of contracts proposed by Ménard (2002) in terms of duration, degree of completeness, incentives and enforcement mechanisms is applied to the study of the embedded unit of case study protocol (see questions in following sub questions)
National Procurement strategy (unit of case study protocol)	New Institutional Economics (NIE) & Procurement literature	Chapter 4: *What type of procurement model do they have?* *What are the rules connecting them and how things actually work?* Description of the mix or combination of contracting practices that make part of a national procurement strategy in terms of Ménard typology and contracting trends (i.e. integration and contractor selection between others) - even within a single (national) institutional environment Account of the results of these practices, taking into account the effect of the institutional environment.
Public administration (procurement of infrastructure in different institutional settings)	Old Institutional Economics (OIE), Evolutionary Theories and Stakeholder analysis	Chapter 5: *How did this model evolve?* *Who are the actors?* *Characteristics of each institutional context, formal and informal institutions* Including the time dimension, a more dynamic and evolutionary view on how have the different countries move towards the present combination of contracting practices. This is achieved by relaxing the assumption of a single most efficient equilibrium and granting extra attention to the impact of the institutional environment and history (initial conditions) on choices made.

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Appendix B

Relationship between conceptual framework and comparative criteria

B.1 Reform and restructuring of road authorities

Reform and restructuring of road authorities: criteria applied origin from concepts on lesson-drawing, NIE and political science.

Table B.1: *Reform and restructuring of road authorities*

Criteria	Origin
Begin or origin	Lesson drawing (events)
Road reform	Governance mechanisms
Drivers	Lesson drawing
Inspiration	Lesson drawing
Actors	Political science (power)
Contractors position	Political science (power)
Obstacles complaints	Lesson drawing

B.2 Procurement strategy or model

Procurement strategy or model: criteria applied origin from theoretical notions as well as list of key issues found in the practitioners' literature on procurement and perfor-

mance contracting and elements from the three main road infrastructure markets.

Table B.2: *Procurement strategy or model*

Criteria	Origin
General advance	Lesson drawing (to position a country as pioneer or example)
Contractor selection	Procurement literature
Integration	Procurement literature
Performance indicators and quality monitoring	Performance contracting and enforcement procedures (NIE)
Alternative financing	Procurement literature
Next steps	Lesson drawing (time dimension)

B.3 Innovative contracting practices per country

Results of innovative contracting practices per country: the criteria applied are mainly efficiency (proposed by NIE as criteria for the selection of the right coordination mechanism) presented in terms of costs and time savings, in addition to criteria related to the expectations of road authorities around the world toward these innovative contracting practices (i.e. not only efficiency but also innovation, professionalization and market development).

Table B.3: *Results of innovative contracting practices per country*

Criteria	Origin
General (results)	Lesson drawing (to position a country as pioneer or example)
Market	Expectations (and evolution related)
Time savings	Expectations (and evolution related)
Cost savings	Expectations (and evolution related)
Innovations	Expectations (problem def)
Expertise and profesionalizations	Expectations (problem def)
Users' satisfaction	Expectations (problem def)
Main challenge	Lesson drawing

B.4 Study of innovative projects

Study of innovative projects (embedded unit): questions formulated match typology of contracts proposed by Ménard (2002) from NIE -in terms of duration, degree of completeness, incentives and enforcement mechanisms- adapted to the specific case of road contracting. The adaptation to road contracting is based on the list of issues found in practitioners' literature on procurement and performance contracting.

Table B.4: *Study of innovative projects*

Question	Origin
What is in the contract? (i.e. project delivery model used, design freedom and innovation)	Duration (related to type of transaction)
What are the key Performance Indicators? What are the real decisive ones to calculate the reward of the contractor?	Incentives (influenced by uncertainty and therefore determining degree of completeness)
What performance indicators does the agency use - but are not used for rewarding? (valuation) or do they use them in the learning process?	Incentives
How is information provided along the project - on how the actual work, construction or maintenance is done? How do they supervise or check contractors?	Enforcement procedures
What strategies did they have to combat the negative effects of information asymmetry? - Or of being misinformed?	Degree of completeness (different role of contracts specially on dealing with uncertainty)
Also in general -how communication between them goes?	Enforcement procedures

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C. Ménard. Enforcement procedures and governance structures: What relationship? In C. Ménard, editor, *Institutions, Contracts and Organizations. Perspectives from new Institutional Economics*, chapter 17, pages 234–253. Edward Elgar, Cheltenham, 2002.

Appendix C

Profile of people interviewed per country

C.1 Finland

C.1.1 National Procurement Strategy

- Director Infra Unit Ministry of Transport and Communication
- Finnra expert in market issues
- Finnra Procurement director
- Project manager and supervisor, Hame regional office
- Finnra Initiator of Reform
- Director of maintenance procurement for Helsinki city (district)
- Finnra expert in Performance Indicators (member of the direction)
- Ramboll expert on periodic maintenance
- Project Manager of Finnish Road Enterprise, the incumbent and largest road contractor
- Project Manager of second largest contractor on routine maintenance (YIT)

C.1.2 Project

- Manager of special purpose company realizing the latest PPP project E-18. This manager is also representative of one larges contractor in Capital Projects (Skanska) and the company that also managed the first PPP project in Finland.
- Finnra Project Manager of the E-18 PPP project
- Members of the team from the consultancy company realizing the design for the latest PPP project E-18

C.2 Spain

C.2.1 Central level

- Maintenance Director of the Ministry of Public Works (Ministerio de Fomento)

C.2.2 Central level (new concessions)

- Exploitation Sub director of Large Concessionaire (Dragados) with more than 25 years of international experience
- Head of Roads Section large consultancy company (Euroestudios)
- Director Infra Administration or largest Spanish consultant - involved in the development of new Performance Based Contract

C.2.3 Gipuzkoa (San Sebastián)

- Transport Infra Technical Director of the Foral Deputation of Gipuzkoa (40-30 yrs experience)
- Manager & Maintenance Director of largest Construction-Asphalt Business (Asfaltos de Campezo)
- Director of Transport and Logistic Cluster (TIL)
- Technical Director of Public Concessionaire (Bidegi)
- Operations Director of Maintenance Concessionaire (Bidelán)
- Director Civil Works of local consultancy company (LKS)

C.3 The Netherlands

C.3.1 Central level

- RWS procurement director
- Person in charge of the formulation of the so called Service Level Agreements (SLAs) that are signed between the Ministry and the Road Administration
- Asset Management and PPP Expert from the PPP Knowledge centre of the Ministry of Finance
- Team member of the Partner Programme for Infrastructure Management (PIM) of the Road Administration (RWS) and initiator and designer of the first innovative contracts in the Zeeland provincial direction
- Directors of the Infrastructures Development department of two of the 5 largest construction contractors (Volker Wessels and Heijmans)
- Director of Business Development of one of the largest specialized contractors on traffic systems and other technical installations (Imtech Nettenbouw)
- Head of the advice department of the association representing all contractors in the construction sector (Bouwend Nederland)
- Member of the Board of Directors of one of the three largest construction contractors (BAM)

C.3.2 Innovative projects

- Procurement manager of the rehabilitation program KOSMOS
- Engineer specialized in systems and maintenance planning from the road administration construction department (Bouwdienst)
- Expert on highway maintenance and member of the Second Coentunnel PPP team from the Road Administration side

Appendix D

Stakeholder analysis before and after the reform

Table D.1: *Position of Actors -Finland before reform*

Actor	Preferences vis-à-vis road reform	Resources
Government (party-politics)	SDP and Communist Party (Left Wing Alliance) represent majority in Parliament. Supported Labour Unions and therefore opposed reform. In 2001 they accepted reform, because Labour Unions had been turned around by Finnra (see below).	Authority. Approval (or not) of 3 laws needed for separating Road Administration and Road Enterprise.
Government (executive) Ministry of Finance	In favour of reform. Cut public spending. Partly initiator of the change	Allocation of public budget. Place reform on political agenda.
Government (executive) Ministry of Transport	In favour of reform. Downside number of employees working in public sector. They preferred therefore the ARA + SOE option (see below).	Authority over Finnra
Finnra (top management)	Actively promoting reform. Dissatisfied with levels of innovation and large size of staff.	Organizational resources. Authority to realize internal reorganizations and make procurement decisions.
	ROLE	Integrated Finnish National Road Administration (Finnra) with both management and implementation tasks
Finnra (operational levels)	Hesitant to say the least. Concerned about transferring freedom to private contractors and job losses.	Implementation of new procedures.
	ROLE	Development and/or guidance of whole design process.
Labour Unions	Against - fear of much people loosing their job. Later convinced by Finnra that creation of Road Enterprise would improve professional prospects of employees.	Power to negotiate from membership of many employees and support of SDP.
Finnish Road Enterprise	Did not exist yet as such, but were Finnra production division then. Exerted pressure through Labour Unions to save jobs.	Sometimes already primary contractor, but without commercial perspective.
	ROLE	Implementation of road construction and maintenance.
Large contractors	Opposed. Fear of more competition from foreign players and new road enterprise.	Market share and potentially new players in the market. Needed for initial internal investments (in skills) to make created market credible.
Medium and small contractors	Opposed. Fear of losing independent contracts with Finnra and becoming just subcontractors of larger players	As large contractors, on a smaller scale.
Foreign contractors	In favour. Swedish and other foreign players wanted access to Finnish market	Potentially new players in the market. Needed for initial internal investments (in skills) to make created market credible.
Consultants	Critical. Mostly about speedy way reform was implemented. Fear of losing role as advisors of the authority to become only sub-contractors of construction companies.	Knowledge for contractors
Banks	Not any strong opinion	Financing capacity

Table D.2: *Position of Actors -Spain before reform*

Actor	Preferences vis-à-vis road reform	Resources
Government (party-politics until 1996)	PSOE and CiU had a majority in parliament and were opposed to reform. Against longer duration of concessions for new projects, against extension of existing concessions, against pre-financing and/or toll-financing of roads leading to lack of public control over expenditure. This would also favour large and vertically integrated companies and increase their profits, lead to higher market concentration. CiU was also concerned about national control over regional infrastructures.	Authority. The only change in need of parliamentary approval was changing maximum concession length in contracting law.
Government (party-politics after 1996)	PP and PNV had privatization as one of its main goals. Also pro-integration in the European Union. Logical alternative for roads therefore is going back to concession model. PNV was also aware that neither national state nor their region could control roads under concession.	Authority. The only change in need of parliamentary approval was changing maximum concession length in contracting law.
Government (executive) Ministry of Finance	In favour, but not passionately.	Allocation of public budget.
Government (executive) Ministry of Transport (Fomento)	In favour. Had already recognized in the infrastructure plan 1993-2007 that there was a serious infrastructure deficit that could not be solved with public funds only. Private money was therefore require for extra construction activities.	Authority. Decision power over general investment plan and procurement practices.
Regional authorities in charge of roads	Some positive (depending on political composition and presence of concession roads) about reform, because they could propose similar models in their regions.	Regional authority. In general full decision power on procurement methods, within imits of general contracting law.
Labour Unions	Not relevant, since no splitting of agency and enterprise took place.	
Users (important because of toll roads)	Mixed. Unhappy to see number of toll roads increase, but aware of need to keep investing in network expansion and lack public funds to cover such investments.	(Toll) Buying power and votes.
Large concessionaires	Positive about returning to concession model. Since most are vertically integrated companies or even have bank or financial institution as part of the group, the choice for alternative contracting would give excellent business opportunity.	Expertise and financing capacity.
Local (smaller) contractors	Opposed to further deregulation and new large-scale and privately financed contracts, making it even harder for them to survive. Fear of becoming subcontractors under abusive terms.	Lobby to PSOE and some regional parties.
Consultants	Not any strong opinion.	Knowledge for contractors
Banks	Pro-reform because of expansion of business opportunities.	Financing capacity.

Table D.3: *Position of Actors -The Netherlands before reform*

Actor	Preferences vis-à-vis road reform	Resources
Government (party-politics)[1]	Not clear position about restructuring of RWS into an agency. Parties like the right-wing VVD have been promoting the idea of using PPP contracting schemes since the beginning, but mainly seen as an improvement in the financing capacity.	Authority. Approval (or not) to grant autonomy to RWS.
Government (executive) Ministry of Finance	First promoter of the use of PPP since 1999. Already in 2004 an evaluation study realized by this Ministry states that PPP projects (in all sectors, not just roads) have proved successful.	Allocation of public budget. Relatively less power than in Finland, specially over Ministry of Transport and RWS
Government (executive) Ministry of Transport, Public Works and Water Management	In favor of RWS becoming an agency. Special interest in downsizing the number of employees working in public sector. A total reduction of 1800 to 2200 employees by 2008, was the only hard goal set for the reform. Mixed signals were given by Minister Peijs between 2004 and 2005 about her believe in PPP schemes and private financing. The position of the government has also been put in doubt by different stakeholders (mainly banks and contractors) in July 2005. "The government create obstacles for a successful public-private cooperation in the Netherlands", this was said by representatives of banks and construction companies during a Parliament discussion in The Hague (July 2005). In 2005, Minister Peijs, believed in the potential of PPP to deliver savings (7 to 14% in the case of the A59).	Authority over RWS
RWS (also in charge of water management tasks)	In favor or becoming an agency to win more financial independence and autonomy from Ministry VenW.	Organizational resources and long tradition of technical expertise. Authority to realize internal organizations and implement new procurement practices as deemed convenient. Nevertheless, their power is of a different nature than in the other two countries. First, due to their additional and very strategic task of safeguarding the country against floods; which gives them more power and voice in the political arena. Second, internally their power and leadership on the local authorities and provincial offices is less than in Finland.

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[1] Note: position is not towards the reform as a whole, but towards the intentions expressed in the First Procurement Strategy (2004-2008) and therein specially towards the use of DBFM for the delivery of construction projects

Table D.3 – continued from previous page

Actor	Preferences vis-à-vis road reform	Resources
Labour Unions	No statements could be found in the news or other sources. Their position was also not that relevant, since as in Spain, there was no splitting of agency and enterprise been considered. Union density[2] in 2003 in the Netherlands was 22.3, while it was 74.1 in Finland and only 16.3 in Spain.	Power to negotiate from membership of employees. Therefore their power is relatively less in the Netherlands than in Finland, but more than in Spain.
Large contractors	In general positive towards the idea of integral contracting and showing ambition to become full service providers since: • Profit margins in this kind of contracts are expected to be higher. • Maintenance contracts are a stable source of payments that diminish the risk and cyclical behaviour of their demand (typical of the construction sector). No particular opinion recorded about RWS becoming an agency.	Market share.
Medium and small contractors	Probably similar to the one of smaller contractors in Finland and Spain. Nevertheless due to ambiguity of government communications about reform; no particular opinion was recorded neither in interviews nor in media communications.	Possibility to lobby in national and European political arenas.
Foreign contractors	No clear position recorded.	Potentially new players in the market of PPP projects. They could contribute with the necessary skills in private financing of which the Netherlands had little within national contractors. Expertise and financing capacity.
Consultants	No clear position recorded.	Knowledge for contractors
Banks	Pro PPP because of expansion of business opportunities. Complaining about the lack of commitment and clarity from the government side (Ministry of Transport), and suspecting them from creating obstacles for a successful implementation of PPP schemes.	Financing capacity

[2]Union density rates are defined as defined as union membership as a proportion of wage and salary earners in employment. Source: Visser (2006), available at: `http://www.bls.gov/opub/mlr/2006/01/art3abs.htm`.

Table D.4: *Position of Actors -Finland after reform*

Actor	Position after reform	Resources
Government (party-politics)	General satisfaction among coalition parties (SDP, Centre and National Coalition which is now larger than the others) about reform result, but little excitement about PPP and long-term contracts, since they tie the government's hand for 20 years or more. Stronger commercial orientation to roads with further reduction of public staff. Use of scorecards and Key Performance Indicators to check quality of private services.	As before.
Government (executive): Ministry of Finance	Positive about results of reform, but against PPP or Private Finance Initiative for fear of losing control over public spending. No belief in savings from optimization of Total Life Cycle Costs to justify the use of more expensive capital.	As before.
Government (executive): Ministry of Transport	Pleased with the results of the reform and promoting its replication to other sectors.	As before, but now exerted indirectly through KPIs and agreements.
Finnra (top management)	Pleased with cost savings and savings in delivery times. Wish to further develop reform bytransferring responsibilities to private sector through more PPP and larger integrated contracts (DB and further) and further reduction of public staff.	As before, except that they lost authority over Road Enterprise part. In addition, they can only exert control over contractors through incentives in contracts.
	ROLE	Road Administration and Road Enterprise have been separated
Finnra (operational levels)	Some resistance to leaving design activities to private parties.	As before.
	ROLE	Approval of contracts and quality checks rather than direct control over construction and maintenance activities.
Labour Unions	Transition was eventually effective, since hardly any people were fired. New FRE workers are happy with their new status in a successful company with access to new related markets.	Weaker than before, since they are less well organized within FRE.
Finnish Road Enterprise	Unabashedly positive	Market share, experience and knowledge of the client. Initially very successful, but recently losing market share to other companies such as YIT.
	ROLE	Quite autonomous - but still has to bring an offer for every work being tendered (even when others are not obliged to do this)
Large contractors	Generally satisfied with gradual opening of market. Only less positive about the selection criteria in the first contracts, giving too many points to quality-experience giving FRE strong advantage over them. In favour of integrated contracts in terms of area and life cycle wise. Dissatisfied with real design freedom being granted and short term of maintenance contracts.	Have grown in importance and experience and increased their market share

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Table D.4 – continued from previous page

Actor	Position after reform	Resources
Medium and small contractors	Some not so happy because of difficulties to new niche. Some still lobby against these new contracts in the national and European arenas (EU). Most small ones are satisfied.	Medium size contractors have lost some weight, because they are mostly subcontractors now, small ones have specialized and feel comfortable.
Foreign contractors	Mixed. Skanska and NCC active in maintenance market, but still with limited market share. Skanska. Due to international experience, Skanska was part of winning consortium in 2 PPP projects.	Grown market share and gained experience in Finland
Consultants	Generally satisfied. Most have adapted to new role and have become partners rather than sub-contractors. Some even developed long-term alliances with contractors to gain future competitive advantage leading to innovation. Some have adopted roles as Quality Auditors of contractors.	As before, but they have expanded the number and width of activities substantially.
Banks	Generally satisfied. Particularly in PPP projects they are now controlling agent.	Financing capacity. Also with an expanded role.

Table D.5: *Position of Actors -Spain after reform*

Actor	Position after reform	Resources
Government (party-politics after 2004)	PSOE and CiU have a majority in parliament again and realize they cannot reverse to direct public funding of infrastructure. They now opt for supporting shadow-toll model instead of direct toll. Defending citizen right to universal and free access to this public infrastructure.	As before
Government (executive) Ministry of Finance	Not any strong opinion.	As before
Government (executive) Ministry of Transport	Satisfied. Network expanded and in relatively good condition. Use of concession model until 2004, shadow tolls afterwards. Aim to replicate concession model (either direct or shadow toll) to maintenance cycle. Not yet happy about application of performance indicators as determinants of payment in contracts.	No formal changes. Procurement still task of Ministry. Reputation as very professional client.
Regional authorities in charge of roads	Depends on political situation. Most satisfied with new practices and extend concession model with direct toll to cover even maintenance costs. Basque country maintains direct toll model, and applies it to maintenance as well. Many have created Public Companies fulfilling role of concessionaire and subcontract competitively the different life cycle phases to keep control of income from tolls.	Authority. Some with Public Companies or Public Concessionaries have lending capacity.
Users	Unwilling to pay toll, but generally used to "user pays principle". Sometimes reluctant to accept toll for existing roads and for maintenance. Some pressure groups strongly against growing shadow toll projects which are believed to lead to much higher expenses in long run.	(Toll) Buying power and votes
Large concessionaires	Generally satisfied, also with Ministry of Transport as professional client. Not totally convinced of pre-financing and/or shadow toll model, for they miss control over market risks and tariffs and they do not like being used as "banks". Performance-based payment determined by government makes them lose freedom of action or poses new kinds of risks.	Expertise and financing capacity. In the last decade they have grown and become strong in international markets due to experience in home market.
Local (smaller) contractors	Generally satisfied. Normally part of larger consortia. Some skeptical about new maintenance concessions, where too many risks are allocated against insufficient reward.	As before.

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Table D.5 – continued from previous page

Actor	Position after reform	Resources
Consultants	Generally satisfied, since they collaborate well with contractors. More used to this situation than Finnish counterparts. Concessionaires in Spain are normally vertically integrated and have large engineering departments, from which some consultancy companies evolved. Some smaller companies upset about arbitrary tendering practices of Public Companies or concessionaires.	Consultants have grown in importance also in maintenance. New maintenance contracts for 19 years using Performance Indicators require consultants to assume risks and have fixed participation of 2 per cent in the special purpose company (consortium).
Banks	Satisfied. Used to work with large concessionaires. 3 national banks very active in this area of private financing of infrastructure.	Financing capacity and expertise, risk management skills.

Table D.6: *Position of Actors -The Netherlands after reform*

Actor	Position after reform	Resources
Government (party-politics)	Positive perception of the advantages of PPP schemes and the potential savings to be achieved. Therefore they all agree on promoting the implementation of this contracting scheme in a wider scale. The reasons for their support are partly different: Centre-left parties like PvdA believe that a wider use of PPP and the procedures that accompany its implementation, like "market scan", contribute to a more transparent decision-making process. Right-wing party, VVD, emphasizes that more projects need to be implemented so as to created enough deal flow for companies. Centre-right party CDA also agrees on the need to create enough deal flow but somehow looks more after the problems being faced by small and medium enterprises as a consequence of large integrated contracts.	As before.
Government (executive): Ministry of Finance	Very positive about the saving potential and the results delivered so far by PPP projects.	As before.
Government (executive): Ministry of Transport	No clear or strong position recorded. They do seem to believe in DBFM private financing schemes and innovative practices, but lack leadership.	As before, but now exerted indirectly through Service Level Agreements (SLAS).
RWS (top management)	Top civil servants are in general quite positive about the benefits of PPP contracting schemes. They wish to further transfer responsibilities to private sector through more DBFM contracts and further reduction of public staff.	As before, except that nowadays they exert a different kind of control over contractors, through incentives built-in in contracts.
RWS (operational levels)	Internal resistance to adapt to new role and new contracting practices. This natural resistance to change plays a larger role than in other countries given the particular Dutch type of policy making and the lack of strong leadership from top layers. As mentioned before, the procurement strategies drafted so far, leave the final decision up to the local authorities. They are free to decide on a project basis which selection criteria and so forth they will apply.	More leverage power than in other two countries studied.

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Table D.6 – continued from previous page

Actor	Position after reform	Resources
Large contractors	In general it could be said that large contractors are positive about changes in contracting practices because in the new situation that larger contracts are set into the market that they can easier win and they can now play a different role. In favor of wider scale use of integrated contracts. Contractors seem especially eager to increase the number of DBFM projects in their portfolio. Larger contractors feel capable of handling more risks and are open to do it, as they believe to achieve in this way, higher profit levels and a more convenient market position. They see an important business opportunity especially in the financing component of these projects. Profit levels are evaluated in approximately 10 to 14% in DBFM contracts, versus 3% in traditional construction projects and 3 to 5% in maintenance contracts. They are aware that competition for this kind or large and complex projects will be between fewer players than in the traditional contracts[3]. In the recent years all five larger contractors -BAM, Heijmans, Dura Vermeer, Volker Wessels, Ballast Nedam-[4] have opened so called Infrastructure Management divisions . This change shows they are preparing for their new roles as service providers with a broad range of mobility solutions. Their perception is that the market is becoming one single "mobility market". They are somewhat dissatisfied with real design freedom being granted in capital projects and believe that other contracting schemes like Alliances, Competitive Dialogues and the possibility to deliver Unsolicited Proposals could help to increase the design space been granted to them. Alliances would also solve their critique about too many risks been transferred to the private sector, so that the project becomes too expensive. They share with cabinet concern about not enough deal flow in PPP projects to justify the needed investments and develop the expertise needed in-house. Other main complaints -about the implementation of some innovative practices are:	Have grown in importance and experience -but to a lesser extent than in other countries.

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[3]Competition is expected to be between three or five contractors in large projects and almost monopoly power if projects are done under an Alliance scheme.

[4]Some of these companies though are not that active in PPP in the Netherlands, have built experience out of the country. Dura Vermeer en Ballast Nedam have participated in PPP projects in England.

Table D.6 – continued from previous page

Actor	Position after reform	Resources
	- Still too many tenders are awarded on the basis of price alone or mainly price - Too many projects are being delayed for more than six months -mainly due to regulations about air quality-, and RWS expect them to stick to the prices promised. - Lack of uniformity. Each organizational unit of RWS interprets contracting guidelines differently. Finally, contractors main critique towards the new performance-based contracts is that sanctions and deductions are too high and some of them even unlimited. The government is requiring too high availability or reliability levels. These risks are valued different by different contractors and therefore in some cases there are offers up to 50% cheaper than others. They believe that the consequences are that either they have to price risks very high -to protect themselves from bankruptcy- or go frequently to court to solve disputes. A similar point is made for PPP projects. They have expressed their preference to discuss about the issue of who takes which risk, instead of all other issues proposed by RWS.	
Medium and small contractors	As in the first years of the reform in Finland, small and medium contractors -specially the ones less specialized- are lobbying against these new contracts in the national and European arenas. Small(er) contractors are against or have a negative perception. Most of all the niche contractors, because if the activities on which they specialized are now included in bigger integrated contracts, they cannot directly compete anymore, they don not have this market anymore.	It seems that not enough contractors of this size have adapted to their new expected role as specialized subcontractors. Support of CDA political party and relatively successful in the lobbying within the European Parliament.
Foreign contractors	Probably satisfied or looking forward towards new opportunities in this market.	Foreign companies have been competing in the Netherlands, but only for DBFM contracts. In recent PPP projects there have been competitors from France, Belgium, Germany and Spain (Dragados). Meanwhile Dutch companies that need to serve as local partners seem to like to cooperate with international partners. They often invite international partners with an specific competitive advantage of expertise; like tunnels, or private financing (like the Spanish company Dragados).
Consultants	No clear position has been recorded.	RWS is making use more and more of their services.
Banks	European Investment Bank (EIB) seems positive and open to finance more projects under PPP scheme.	Financing capacity.

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Appendix E

Dutch procurement standard instruments

E.1 System-oriented contract management approach

Systeemgerichte contractbeheersing (SCB) is the method developed by RWS to implement the so called own responsibility principle; where the contract is managed "at a distance". In brief the main idea is testing the functioning or the way of working of the contractor management system. The main characteristics of this approach follows:

- The client (road agency) makes use of the information gathered by contractors in their own project management system.
- The tests realized derive from a risk analysis. Here more attention is paid to the risks of which RWS will finally bear the responsibility for, like safety and road availability.
- The particular mix of tests and frequency of testing is based on contract specifications and the risk profile of the project, which means that these two elements vary per project.
- In general there are two types of system tests, audits and test of contractor's quality plan.
- In case of deviations it is the contractor' responsibility to detect these deviations on time and make the necessary corrections in the bookkeeping and well as in the physical system. Meanwhile it is the agency responsibility to: (a) confirm the information received from the contractor and let him know if deviations have been found, (b) test again after contractor has performed corrective measures and (c) if the problem has not yet been solved give him a sanction.

- This new methodology implies that contractors becomes more and more experienced and able to control their own processes, to design and build products of good quality for which they can extend a guarantee for a reasonable period of time.
- It also implies that the role of the client (road agency) will go as far as to formulate functionally the work or project desired and once it has awarded it to a particular contractor, it will limit to the random (incidental) and risk-based monitoring if the contractor acts according to his promises.

Source: Lee (2007)

E.2 The Most Economically Advantageous Tender Approach (MEAT)

Economisch Meest Voordelige Inschrijving (EMVI) in Dutch

EMVI is a principle that can be applied to all types of contracts and to all tendering procedures, if besides prices also other elements are taken into account in the decision of awarding a contract.

It makes a difference between three types of awarding/selection criteria:

- Price criteria: a price criterion has a direct one-to-one relationship between the price and the EMVI-value assigned, the most clear example is the price offered in the tender by the contractor (subscription price);
- Performance criteria: a performance criterion is expressed in terms of performance-units; the EMVI-value for this tender is the product of multiplying the performance-unit by the performance-value per unit; an example: a project will be finished four weeks before time and the value of this performance is €10.000/week, so that this criterion represents a EMVI-value of €40.000;
- Quality criteria; a quality criterion is quantified by first assigning a number of appreciation points to each candidate. Afterwards the EMVI-values are calculated by multiplying the amount of appreciation points assigned by the value per point. The latter is fixed by a percentage of the subscription price.
- It can also be applied by using a simplified model where besides price only one or few performance criteria are applied.

E.2.1 Application of EMVI in practice

The Corporate Strategy of RWS (2004-2008) uses a ratio price/quality of 60%/40%. Nevertheless as in this ratio only four quality criteria are taken into account and because these four are not always possible to apply, it could be that this ratio (60%/40%)

is not achieved. It can also happen that these four quality criteria do not cover all the relevant value aspects of a project. The choosing of criteria and the way of valuing them is therefore customized per tendering situation (or project). This ratio 60%/40% means that from the total EMVI-value (100%) 60 percent is reserved to prices and 40 percent to quality. The 40% of quality is assigned according to the following four criteria:

- The result of earlier performance or quality of service delivered (15%)
- The technical quality (10%)
- Sustainability (10%)
- Aesthetics (5%)

In some innovative DBFM projects, as the 2nd Coentunnel and additional criterion taken as part of the EMVI-value is the list of risks that the contractor proposes to assume.

As it can bee seen the intention is to attach an important value to the quality of the processes or performance by applying the instrument of "performance measurements of contractors" or the so-called past performance. However at this point in time this is not possible since these criteria conflicts with European tendering regulations.

Source: Crucq and Schillemans (September 2006)

References

H. Crucq and J. Schillemans. *Handreiking EMVI. Economisch Meest Voordelige Inschrijving. Versie 2.0.* Expertise Centrum Opdrachtgeverschap, September 2006.

E. van der Lee. Systeemgerichte contractbeheersing bij design en construct contracten. Aanpak en ervaringen bij rijkswaterstaat. Presentation, October 2007.

Appendix F

Performance specifications

Table F.1: *Performance Indicators included in the Spanish contract*

No.	Indicador (Spanish)	Indicator
1	Firmes. Resistencia al deslizamiento	Pavements (road surface). Skid resistance
2	Firmes. Macrotextura	Pavements. Macrotexture
3	Firmes. Regularidad superficial longitudinal (IRI)	Pavements. International Roughness Index (IRI)
4	Firmes. Capacidad estructural (flexibles, semiflexibles y semirrígidos.	Pavements. Structural strength
5	Firmes. Regularidad transversal (roderas)	Pavements. Transversal profile (ruts)
6	Firmes. Fisuración y otros deterioros superficiales. (Firmes flexibles, semiflexibles y semirrígidos)	Pavements. Cracks and other superficial deteriorations
7	Firme. Fisuración en firmes de hormigón	Pavements. Cracks in concrete pavements
8	Firmes. Transferencia de carga en firmes de hormigón no continuo	Pavements. Load transfer in non-continuous concrete pavements
9	Firmes. Asentamiento	Pavements. Settlement
10	Firmes. Baches	Pavements. Potholes
11	Firmes. Limpieza de firmes & drenante	Pavements. Cleaning of porous pavements
12	Taludes	Embankments
13	Siegas, podas y desbroce	Grass cutting and pruning of trees and shrubs
14	Mantenimiento de plantaciones	Maintenance of plantations
15	Limpieza de calzada y arcenes	Cleaning of highway and borders
16	Puentes	Bridges
17	Vialidad invernal	Winter maintenance
18	Seguridad vial. Índice de peligrosidad	Road safety. Danger index
19	Seguridad vial. Índice de mortalidad	Road safety. Mortality index
20	Seguridad vial. Actuaciones en TCA	Road safety. Works realized in areas of high concentration of accidents
21	Marcas viales. Retrorreflexión	Road signs. Retro reflexion
22	Marcas viales. Resistencia al	deslizamiento Road signs. Skid resistance
23	Marcas viales. Luminancia	Road signs. Brightness

Continued on next page

Table F.1 – continued from previous page

No.	Indicador (Spanish)	Indicator
24	Señalización vertical	Vertical signs
25	Limpieza de márgenes y áreas de descanso	Cleaning of road sides and rest areas
26	Limpieza y reparación de drenaje	Cleaning and reparation of drainage
27	Funcionamiento de la iluminación	Functioning of lighting system
28	Túneles. Elementos estructurales	Tunnels. Structural elements
29	Túneles. Revestimientos	Tunnels. Coatings or top layers
30	Túneles. Iluminación	Tunnels. Lighting
31	Túneles. Ventilación	Tunnels. Ventilation
32	Túneles. Extinción de incendios	Tunnels. Fire extinction system
33	Túneles. Instalación eléctrica	Tunnels. Electrical installations
34	Túneles. Sistema de comunicación	Tunnels. Communication system
35	Túneles. Sistema de vigilancia	Tunnels. Surveillance system
36	Túneles. Despeje zonas de emergencia	Tunnels. Keeping open of emergency areas
37	Barreras y elementos de contención	Guard-rails and contention elements
38	Atención a incidentes y accidentes	Attention and Management of incidents and accidents
39	Ocupación de carriles	Lane occupation
40	Nivel de servicio	Level of service
41	Vigilancia	Supervision and surveillance

Table F.2: *Overview of requirements for E-18 project*

	Performance specifications	**Technical requirements**	**Method descriptions /requirements**	**Hand-back requirements**
Traffic engineering	Top surface of the road	Road sections excluded from the maintenance period	Related to the measurement methods	Delivery condition of the top surface and structure
Geotechnics	Stability and roughness (settlements)	Mainly related to materials	Related to the measurement methods	Rate of settlements and calculation of the possible depreciations
Bridges	Common technical requirements	Most of the requirements, also bridge-specific	Mainly related to maintenance	Allowed degree of damage
Tunnels	Long-term structures...	meet mostly with the technical requirements and...	method descriptions	Repair of damages or depreciations, remaining service life of devices
Fittings and equipment	Majority	Mainly related to technical systems	None except traffic management	Operational condition
Environment and architecture	General output specifications	Mainly related to some technical solutions and visual appearance	Inspections and quality reports	Several definitions according to the environmental theme
Routine maintenance	General output specifications...	...complemented by technical and quality requirements	Some method descriptions	None

Appendix G

Payment mechanisms of innovative PPP projects

G.1 The Dutch Second Coentunnel project: availability payments

$NBV = BBV - BC - PK$

Where:

- BBV is the gross availability fee (Bruto Beschikbaarheidsvergoeding).
- BC is the availability correction (Beschikbaarheid correctie). This is equal to the sum of all deductions due to closing of lanes. Each deduction is equal to the number of hours multiplied by the value of the hour. The value of the hour depends on the time of the day or week (peak hours during the day are the most expensive, then follows the weekend, and the cheapest are nights -between 23.00 and 5.00), type of lane being closed and type of closing (total closing or limits in speed).
- PK is the performance reduction (Prestatiekorting). This is equal to the BBV multiplied by the "deduction percentage". This percentage is calculated on the basis of number of total sanction points. Sanctions can be due to shortcomings of contractor in ensuring safety (the highest -10 points-being if a mistake of the contractor does result in a traffic accident) or shortcomings in process management (the highest - also with 10 points- if contractor fails to follow or act according to his/her own quality management plan). Up till the delivery date the contractor will be paid only 20% of the gross availability fee. After delivery he will be paid based on 100% of the gross fee. Besides upon completion of the project he will receive a one-time payment of around €200 million.

G.2 Spanish A-2 concession: shadow tolls

Payments will be realized monthly and calculated based on the utilization and quality of the Highway, which from this moment on will be called "demand criterion" or "canon de demanda" in Spanish.

(1) Demand criterion: the demand criterion is determined as a function of:

- Type of vehicle.
- Number of vehicles-km of each type that drives on the highway.
- The offered tariff applicable to each type of vehicle per kilometre covered (basic tariff).
- The percentage of the unit tariff that is used for the computation of the "demand criterion" of the traffic that exceeds the maximum annual level of traffic set.

(2) The correction factors, downward or upward, of the performance of the concessionaire, understanding the 41 indicators set as objective standards that will be used for the periodic evaluation of the degree or quality of compliance, correlating quality level with reward. Downward correction factors will be applied also when the relative non-compliance of the indicator gives cause for the application of penalties.

(3) For the calculation of the previous factors, two types of vehicles will be considered:

- Light vehicles: all vehicles which length is 6 meters or less.
- Heavy vehicles: all the others.

The corresponding tariff for heavy vehicle will be 40% more than the one set for light vehicles.

(4) The tariff applied for the computation of monthly payments will be the "corrected tariff":

$$\text{Corrected tariff} = \text{Basic tariff} \cdot F_t$$

and:

$$F_t = 1 + \sum_{i=1}^{n} \frac{fc_i}{100}$$

Where fc_i are all the correction factors obtained from the compliance of the contractor according to the 41 indicators set.

(5) The concessionaire will have no right to receive economic remuneration from the administration during the first year of the contract. Beginning from the first year of the contract, the tariff will be calculated applying to the base tariff a percentage equal to the investment percentage of the works of Area 1 that were already in service at the end of the previous year of the concession.

Glossary

Added value

Added value, also "value for money" means higher quality for the same money or the same quality for less money.

Auction

A method of selling real estate in a public forum through open and competitive bidding. Also referred to as: public auction, auction sale or sale. Auctions take many forms but always satisfy two conditions: a) They may be used to sell any item and so are universal, also b) The outcome of the auction does not depend on the identity of the bidders; i.e., auctions are anonymous. Most auctions have the feature that participants submit bids, amounts of money they are willing to pay. Standard auctions require that the winner of the auction is the participant with the highest bid. A nonstandard auction does not require this (e.g. a lottery).

Auction theory

Auction theory is an applied branch of game theory which deals with how people act in auction markets and researches the game-theoretic properties of auction markets. There are many possible designs (or sets of rules) for an auction and typical issues studied by auction theorists include the efficiency of a given auction design, optimal and equilibrium bidding strategies, and revenue comparison. Auction theory is also used as a tool to inform the design of real-world auctions; most notably auctions for the privatisation of public-sector companies or the sale of licenses for use of the electromagnetic spectrum.

Awarding

The project is awarded to the company whose bid scores best against the predefined award criteria. (See also Specifications).

Award

The issue of an order or contract to a supplier as a result of a competitive tendering or bidding process.

Build-Own-Operate

A private contractor constructs and operates a facility while retaining ownership. The private sector is under no obligation to the government to purchase the facility or take title.

Build-Operate-Transfer (BOT)

See Design-Build-Finance-Operate. BOT is defined as a delivery method in which the client procures design, construction, financing, maintenance and operation of the facility as an integrated whole from a single producer. The client provides initial planning and functional design. A BOT project is a concession contract in which a principal, grants a concession to a concessionaire who is responsible for the construction and operation of a facility over the period of the concession before finally transferring the facility, at no cost to the principal, as a fully operational facility.

Cash flow

Costs, income and risks which together determine the profitability of the project.

Competitive Dialogue

A variation of the negotiated process, now available under new European Union Rules, that allows different options to be discussed before a particular solution is selected. It can be used in complex contracts where technical solutions are difficult to define or where the buyer needs the best solution to be developed.

Concession

The exclusive right granted to a commercial organization to exploit a specific project for a defined period of time. A contract under the terms of which a public authority accords specific rights to a company to construct, maintain and/or operate a network for a given period.

Concession Benefits

Rights to receive revenues and other benefits (often from tolling) for a fixed period of time.

Concessionaire

Consortium that undertakes the contract to design, build, operate and maintain the scheme the holder of a concession. Someone who holds or operates a concession.

Contract

A legally enforceable agreement. It is a formal, legal commitment to which each party gives express (though not necessarily written) approval and to which a particular body of law applies.

Contract Documents

Documents incorporated in the enforceable agreement between a public sector body and a contractor, including contract conditions, specification, pricing document, form of tender and the successful tenderers responses (including method statements), and other relevant documents expressed to be contract documents (such as correspondence, etcetera).

Consortium

An unincorporated group of firms or individuals which has been formed with a view to pooling their strengths and resources to win contracts that they would not be able to in their own right.

Construction Manager at Risk

Hired construction manager (CM) begins work on the project during the design phase to provide constructability, pricing, and sequencing analysis of the design. The CM becomes the design-build contractor when a guaranteed maximum price is agreed upon by the project sponsor and CM.

Cost Plus

The method of payment for contracts for which tenderers quote a lump sum or addition (margin) to their costs.

Design-Build (DB)

A delivery strategy in which the client procures both design and construction from a single contractor. Initial planning, functional design, financing, maintenance, and operation of the facility remains as separate, segmented elements of the project, each of which is provided by the client.

Design-Bid-Build (DBB)

The traditional project delivery method where design and construction are sequential steps in the project development process A segmented delivery strategy in which design is fully separated from construction, both of which are, in turn, separated from maintenance and operation of the facility.

Design-Build-Finance (DBF)

An innovative project delivery method under which design, construction and financing are placed in the hands of a private party or a consortium of private parties.

Design-Build-Finance-Maintain (DBFM)

A contract (as used for the PFI) in which the service provider is responsible for all four aspects of the provision and operation of an asset.

Design-Build-Finance-Maintain-Operate (DBFMO)

The design, construction, financing, maintenance and operation are placed in the hands of a private party or a consortium of private parties.

Design-Build-Finance-Operate (DBFO)

Also refer to BOT, a commonly used delivery method that is synonymous with DBFO. DBFO is defined as a delivery method in which the client procures design, construction, financing, maintenance, and operation of the facility as an integrated whole from a single contractor. The Client provides only initial planning and functional design. As defined here, the DBFO method puts the risk that project receipts will be insufficient to cover all project costs and debt service squarely on the contractor.

Design-Build-Operate (DBO)

Is defined as a delivery method in which the client procures design, construction, maintenance, and operation of the project from a single producer or contractor. The client provides initial planning and functional design. The DBO procurement method is defined to require that the client directly provide some portion of the cash flows required by the producer to finance all of the tasks assigned by the client. This financing is typically provided in one of two ways (and sometimes as a combination of the two): (a) direct cash payments by the client, or (b) delivery by the client of the equivalent of direct cash payments to the producer, such as the right to collect user charges. Even if the successful producer is required to provide some portion of the funding stream required for project delivery or operation, such projects are classified as DBO.

Framework Agreement

A formal agreement with selected (or short-listed) suppliers. The purpose is to establish the terms of contract - in particular with regard to price and quantity. In other words, a framework agreement is a general term for agreements with a number of suppliers which set out terms and conditions under which specific purchases (call-offs) can be made throughout the term of the agreement.

Infrastructure

The term "infrastructure" is used in a broad sense to mean, collectively, (a) capital facilities such as buildings, housing, factories, and others structures which provide shelter; (b) the transportation of people, goods, and information; (c) the provision of public services and utilities such as water; waste removal, minimization and control; and (d) environmental restoration.

Incentives/disincentives

The contractor is paid for early completion of a project as provided for in the contract. If the contractor completes the project later than the time allowed, disincentive money is subtracted from payments due.

Innovative contracting

A procurement option whereby several elements of a project are integrated into one project, usually based on option output specifications to allow for private sector knowledge and innovation. Examples of innovative contracting include: design-build, design-build-operate, design-build-finance-operate-maintain.

Institution

The rules of the game: the humanly devised constraints that structure human interaction. They are made up of formal constraints (such as rules, laws, constitutions), informal constraints (such as norms of behaviour, conventions, self-imposed codes of conduct), and their enforcement characteristics.

Invitation to Tender (ITT)

The paper or electronic documentation issued to organisations invited to tender for a contract. Typically, it includes a background, rules of tender, contract specification, questions or information required and a draft contract. Usually after a pre-qualifying or registration stage, a small number of businesses (often between five and eight) are invited to submit a tender bid or priced proposal. The ITT sets out the key criteria you need to meet, and tells you how to submit your tender.

Joint Ventures (JV)

A formal or informal partnership created to achieve a specific aim - typically to win a tender or PFI, PPP etcetera.

Key Performance Indicators (KPIs)

Key Performance Indicators. Important (set of) measures by which the client will assess bids and performance in fulfilling the contract.

Life-Cycle Costs

The costs of a project over its entire life: from project inception to the end of a transportation facility's design life.

Most Economically Advantageous Tender (MEAT)

The optimum combination of the complete life costs and benefits assessed against predetermined evaluation award criteria which will normally be detailed in the Invitation to Tender (ITT) or equivalent documentation.

Multi-parameter bidding (A+B+Quality)

In contrast with the traditional low-bid system where price is the sole basis for determining the successful bidder, the multi-parameter biding system includes various owner-selected parameters, such as cost, time, and quality. Each of these parameters need a proper quantification and bidder evaluation methodology.

Negotiated Procedure

For high-value public sector contracts (see OJEU) - only chosen suppliers are invited to negotiate for a contract(s). This has limited use only e.g. extreme urgency, failure of open/restricted procedures or repeat of similar contract.

Net present value (NPV)

Costs and revenues of the project are expressed over time and are calculated back to their net present value (NPV). This calculation is called discounting. By discounting all the costs and income for the project the Net Present Value can be calculated.

Partnering

Technically, partnering is not an alternative dispute resolution method. Rather, partnering is a change in the attitude and the relationship between owner and contractor.

It is the creation of a relationship between the owner and contractor that promotes recognition and achievement of mutual and beneficial goals. Partnering occurs when trust, cooperation, teamwork and the successful attainment of mutual goals become the hallmarks for the relationship.

Partnering may also mean a working relationship between two or more parties either creating added value for the customer or as a means to win contracts that individually they may not be successful with. Partners can include suppliers, distributors, joint ventures, and alliances. Note: Suppliers may not always be recognised as formal partners. (Also see Joint Ventures.)

Path dependence

A condition that exists when the outcome of a sequence of economic changes can be significantly influenced by temporally remote events, including happenings dominated by chance elements rather than systematic forces.

Performance specifications

The Pay-for-Performance specifications rely on final outcomes measured against performance criteria set forth in the contract. If the contractor fails to meet minimum performance criteria, payment is withheld and corrective action is required.

Private Finance Initiative (PFI)

A form of partnership between the private and public sector which is normally used for high risk/high value contracts, principally to raise money for higher value projects. Private sector investment into public sector projects provides a way of funding major capital investments, without immediate recourse to the public purse.

Procurement

The process of acquiring goods, works and services, covering acquisition from third parties and from in-house providers. The process spans the whole life cycle from identification of needs, through to the end of a services contract or the end of the useful life of an asset. The term used to describe how a company or contracting authority buys or agrees contracts for goods, works and services.

Project

The term "project" is used to refer generically to a discrete tasks performed in connection with part, or all, of an infrastructure facility, or service. Projects are often arranged to be performed by private or public owners ("clients") through contracts awarded to

suppliers, designers, contractors, design-builders, design-builders-operators , operators ("producers") for all or part of a capital facility, repair or replacement of components of such facilities, or for services relating to infrastructure facilities.

Public Private Partnership (PPP)

Very similar to a PFI arrangement, but the aim is centred more on service delivery than finance. PPP is a form of cooperation whereby public authorities and private parties share responsibilities and risks.

A contractual agreement formed between public and private sector partners, which allows more private sector participation than is traditional. The agreements usually involve a government agency contracting with a private company to renovate, construct, operate, maintain, and/or manage a facility or system. While the public sector usually retains ownership in the facility or system, the private party will be given additional decision rights in determining how the project or task will be completed. The term public-private partnership defines an expansive set of relationships from relatively simple contracts (e.g., A+B contracting), to development agreements that can be very complicated and technical (e.g., design-build-finance-operate-maintain). In the context of this report, the term public-private-partnership is used for any scenario under which the private sector would be more of a partner than they are under the traditional method of procurement.

Public Sector

Specifically, the term "public sector" refers to all bodies that are governed under public law. For member states of the EU (European Union), this means, primarily, central government and all its associated departments, regional and local authorities, state owned utilities, the National Health Service, the police service, the armed forces (MOD), universities and colleges, prisons and devolved administrations in Scotland, Wales and Northern Ireland. The term also covers all European institutions including the EC (European Commission) and its related projects and programmes Providing goods or services to the public sector represents a vast opportunity to businesses of all sizes and composition. The value of the spend by local government alone in 2008 will exceed £40 billion. Moreover, there is now a specific focus in public accounting to show that equal opportunity has been afforded to small and medium-sized businesses, businesses owned and managed by minorities and start-up concerns. Providing that a business can securely and demonstrably meet the terms and conditions of the tendered contract, and has the logistic and internal infrastructure to carry out the services to the levels demanded by the SLA (Service Level Agreement), then it is usually assured of equal participation rights. All public sector authorities are subject to European public procurement rules which are intended to ensure an open and fair market for suppliers, a visible and auditable contracting process and equal access to contract opportunities for all suppliers.

Public procurement rules are defined in a series of EU directives implemented at national level through regulations and other forms of legislation.

Apart from the provision of a consistent set of procurement rules across the EU, the principal aims of the regulations are to eliminate discriminatory and uncompetitive practices that run counter to the public interest and to ensure the good stewardship of public funds.

Variations to procurement regulations at local level are acceptable as long as they do not contravene existing UK or EU rules, accounting principles or the requirements of statutory legislation. It is also possible to have varying applications of the rules within a single contract, by different purchasing officers or departments.

Public Sector Comparator (PSC)

The Public Sector Comparator equals the hypothetical whole-of-life risk-adjusted cost of government delivering the project. PSC is a hypothetical riskadjusted costing, by the public sector as a supplier, to an output specification as part of a PFI procurement exercise.

Rent-seeking

The outlay of resources by individuals and organizations in the pursuit of rents created by government.

Right of way

A right-of-way is a strip of land that is granted, through an easement or other mechanism, for transportation purposes, such as for a rail line or highway. A right-of-way is reserved for the purposes of maintenance or expansion of existing services.

All public roads are located within land which is referred to as road right-of-way. Within a typical road right-of-way, the following public facilities can be found: the driving surface, roadside shoulders and ditch, public utilities, sidewalks, and traffic signs to name a few.

Right-of-way construction permits are issued for the installation, repair, and/or replacement of standard works in the public right-of-way or a public easement. An easement is a non-possessory interest to use real property in possession of another person for a stated purpose. An easement is considered as a property right in itself at common law and is still treated as a type of property in most jurisdictions.

Risk

In general a risk concerns the expected value of one or more results of one or more future events. In the road sector risk refers often to an event that may or may not

happen that can result in the project been delivered late, in cost overruns or in failure to satisfy the defined quality requirements. The most important sources of risks are: (a) Risks during the preparation phase; (b) Risks during the transaction phase; (c) Risks during the realisation phase; (d) Risks during the exploitation phase; (e) Risks concerning income. Using the list of costs and income elements you made above, you identify per element the most important risk factors.

Risk allocation

The distribution of risks between the different parties.

Service Level Agreement (SLA)

A mechanism for helping a service provider and its customers achieve a shared understanding about services and service delivery. An SLA is a tool that helps manage the expectations, clarify responsibilities, and provide an objective basis for assessing service delivery. See also Key Performance Indicators.

Shadow Tolling

Shadow tolls are not paid by facility users. Shadow tolls are payments made by government to the private sector operator of a road based, at least in part, on the number of vehicles using the road. First proposed by the UK Government in 1993, they are currently in operation on some roads in the UK. The system of shadow tolling provides the revenue for privately-funded road schemes under the Private Finance Initiative known as the Design, Build, Finance and Operate (DBFO) programme. They have also been adopted in other countries.

Specification

The specification is a document containing information about the required input; companies draw up their tenders based on this document. A description of requirements and standards to which the goods, works or services should conform. Also known as a statement of needs, a statement of requirement, an operational requirement, or a brief. Its purpose is to present prospective suppliers with a clear, accurate and full description of the organisation's needs, to enable them to propose a solution to meet them.

Sub-contracting

The process where a contractor assigns part of the contract to another contractor(s).

Tender

An official written offer to an invitation containing a cost proposal to perform the works, services or supplies required, provided in response to a tendering exercise. This normally involves the submission of the offer in a sealed envelope to a specified address by a specified time and date.

Tender/Tendering

A formalised process of bidding for work or contracts. See ITT.

Tender documents

Documents provided to potential tenderers when they are invited to tender and which form the basis on which tenders are submitted, including instructions to tenderers, contract conditions, specification, pricing document, form of tender and tenderers' responses.

Tender evaluation

Detailed assessment and comparison of offers from contractors, suppliers or service providers. Normally focuses on examining how the tender proposals will deliver the service (quality) and the cost of the service (price).

Tolling

The process of collecting revenue whereby road users are charged a fee per roadway use. Tolls may be collected on a flat-fee basis, time basis, or distance basis and may vary by type of vehicle.

Total costs of ownership (TCO)

Systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset.

Transaction

A transaction occurs when a good or service is transferred across a technologically separable interface.

Transaction costs

The costs of resources utilized for the creation, maintenance, use, and change of institutions and organizations. They include the costs of defining and measuring resources

or claims, the costs of utilizing and enforcing the rights specified, and the costs of information, negotiation, and enforcement. Nevertheless in the context of this study, transaction costs are the costs associated with the development of the initial option studies, tender documents and contract models. These are the costs involved in the invitation to tender process. These costs include: (a) legal, technical and financial support; (b) drafting the tender documents; (c) assessing the bids and negotiating with private parties. Transaction costs are also on the contractor side, and include all the costs incurred by the contractor in preparing an offer or bid.

Value engineering (VE)

VE is a systematic review process that analyzes a project's design, and develops recommendations to improve design and/or reduce cost.

Value for Money

The provision of the right goods and services from the right source, of the right quality, at the right time, delivered to the right place and at the right price (judged on whole life costs and not simply initial costs).

Warranties

Warranties require contractors to guarantee all or portions of a construction project to be free of defects in materials and workmanship for a period of time. The contractor is required to correct deficiencies that occur during the warranty period.

When used in public-private partnerships for the construction of roads, warranty clauses guarantee that the roadway will meet a certain level of quality or else repairs will be made at the private contractor's expense. There are currently two types of warranties used in highway construction: (1) materials and workmanship warranties and (2) performance warranties. Under the first type, the contractor is responsible only for defects caused by poor materials and workmanship. Under the latter, the contractor is responsible for the product meeting certain agreed upon performance thresholds, regardless of whether materials and workmanship met State standards.

Summary

Innovative contracting practices in the road sector:
Cross-national lessons in dealing with opportunistic behaviour

Problem description and research design

Over the past fifteen to twenty years, the world has seen a proliferation of innovative approaches for the delivery and financing of public services, as part of a growing interest in private sector involvement. This interest has been prominent in the procurement of public-use infrastructure such as roads, rail, water and buildings, and in the use of Public-Private-Partnerships (PPPs) as project delivery method. PPP projects represent more than a trillion dollar investment in planned or completed infrastructure projects worldwide since 1985.

The shift towards market forces started in the United States in the 1970s, with rail, power and telecom deregulation. During the mid-1980s, Spain, Chile, New Zealand and, most actively, the United Kingdom, expanded the portfolio to encompass new risk-sharing arrangements for the delivery of public works infrastructure projects and services.

Since the late 1980s, PPPs have come to the fore in various countries around the world in the provision of infrastructure. In the transportation sector this development has come along with a revival of interest towards the old concession model of toll roads, who had been out of favour for many years.

In all sectors and most countries worldwide, the growing interest towards PPP approaches or the search for alternative financing and delivery methods, has been mainly triggered by the increasing gap between infrastructure financing requirements and revenues. PPPs are seen as a way to expedite critical infrastructure that may otherwise not be built. They are increasingly attractive to governments seeking financial discipline, as public agencies are able to deliver these new facilities using private sector resources without inevitably committing public debt or equity.

More than a third of the public-use infrastructure planned (roads, rail, water and buildings) since 1985, or completed by October 2008, concerned road projects, including

highways, bridges, and tunnels. Europe has the largest PPP infrastructure programme in terms of road and rail project costs. The European road programme amounts to $ 298,9 ($ 136) billions versus $ 91,6 ($ 56,3) billions of the Latin American road programme.

The term PPP is often used by authorities to refer to project delivery methods that involve private financing of infrastructure for a long term, such as Design-Build-Finance-Maintain (DBFM) projects or concessions. However, understood in its wider sense the term PPP covers an ample variety of project financing and delivery approaches. PPP projects can involve a wide range of responsibilities and risks for the public and private sector partners. The nature and extent of private sector involvement in PPP projects can range from long-term service contracts to full financing, development operations and preservation, with the private sector taking increasing responsibility for various functions comprising the infrastructure asset life-cycle, such as Manage, Design, Build, Operate, Maintain, Finance and/or even Own.

The transfer of risk and responsibility to the private contractor goes naturally hand in hand with delegation of control, the transfer of additional decision rights in determining how the project or task will be completed. As a result of these two characteristics, transfer of risk and of decision rights, the potential of PPPs also brings a number of challenges with it as the complexity of regulating and managing such contracts only increases.

The complexity and difficulty of drafting proper contracts becomes apparent from the large differences in results obtained by different countries. Especially with regard to private financing initiatives, impressive outcomes have been achieved by countries like Australia and Chile. Meanwhile, the 1990s road concession programme in Mexico has become known for its catastrophic outcomes, as it resulted in massive government bailout.

The most difficult task is to arrive at a balanced and acceptable sharing of responsibilities, risks and rewards together with the private sector. Government expectations of the savings to be achieved through innovative contracting arrangements have resulted in many cases in biased optimism on both sides. The problem is that in many cases, the outcome of excessive optimism is renegotiation. As a result of unrealistic and aggressive bids, a large number of projects face renegotiation.

To successfully conclude a PPP project is a challenge. An effective design of the contract before the project start is crucial, since often there is little more for a public agency to do than ensure that all involved parties comply with their contractual commitments.

Four trends are perceived in road contracting. Firstly, projects are contracted for the whole life cycle of the road. Secondly, contractors are given increasingly more freedom of design, as the indicators used for monitoring their work become less operational and more performance based. Thirdly, more projects are financed by private investors. Fourthly, contracts tend to be granted for the longer term.

Not until the last 15 years, have these alternative project delivery models or contracting arrangements been used or tested for road infrastructure. Prior to the recent reforms in the road sector around the world, most public authorities followed the so-called traditional procurement model. Operation and maintenance tasks were realized mainly by road authority in-house personnel and infrastructure projects were financed directly, with public funds. Outsourcing took place on an adhoc basis.

Expectations are high: more contract flexibility in the road sector, more innovation, higher performance and consequently lower costs, while keeping up service levels on public values, such as mobility, safety and the environment. But how successful have road authorities been in implementing such innovative arrangements in practice? And how can the positive results expected in fact be achieved? Are there also possible tensions between the aspects of contract flexibility and those regarding public values?

The policies implemented to increase contract flexibility and to grant additional decision rights to contractors may actually increase the problem of information asymmetry between authority and contractors, because contractors probably hold more private information, which is not available to the authority. This informational advantage gives contractors more opportunities or room to act opportunistically and eventually in detriment of the network condition, threatening the fulfilment of public values (e.g. availability, accessibility, safety and affordability).

Therefore, the most challenging problem being faced over the last decades by national road infrastructure administrators as well as many other administrators of network bound infrastructures can be formulated as a trade-off: *How to achieve the positive results expected from innovative contracting -mainly improvements in efficiency and innovation-, while keeping the room for opportunistic behaviour (on the part of contractors) and its (negative) effects at the minimum possible?*

The present study aims to answer this question by investigating whether and how different countries and their national road administration authorities have found solutions to this issue and to draw lessons for road authorities around the world.

The research has been designed as consisting of two main elements, a cross-national comparative study of contracting practices and a gaming-simulation tool.

The first element of the research is a cross-national comparative study designed as a multiple case study research with embedded units of analysis. The main unit of analysis is the national procurement strategy with all its components. The embedded units are projects, preferably Public Private Partnerships (PPP) projects that embody such innovative contracting practices. Case studies have been realized in Finland, Spain and the Netherlands.

The historical recount of the national reform and procurement models realized through case study research is complemented with a gaming-simulation tool, "Road Roles", in order to explore long-term effects of future scenarios in innovative contracting, especially for the case of periodic road maintenance where fundamental reforms are expected.

The theoretical basis of this research project combines economics (agency theory, new institutional economics, old institutional economics and other evolutionary theories) with engineering design theory. In addition the methodologies that supported the development of a case study protocol and a generic tool (gaming-simulation) as well as the analysis of the empirical data gathered are system analysis (system dynamics), stakeholder analysis, case study research and gaming-simulation.

Dynamic comparative framework of national procurement models

The development of a research strategy has meant a process of continuous enrichment of the conceptual framework with notions and assumptions adopted from different theoretical bodies. The main steps followed in this process as well as the contribution of each of these theories to the analysis of contracting practices follow.

First, agency theory in combination with few concepts from engineering design is used in a first analysis of the problem and of the system. In accordance with the assumptions of agency theory, in this first analysis contracts are considered as self-enforcing, closed system or self-containing, without considering the influence of institutions.

Second, from this first formal analysis it becomes clear that the implementation of innovative road contracting practices (longer duration, transfer of risks and higher uncertainty) means a change from "classical contracts" to "neoclassical contracts". Agency theory applies rather to classical contracts where the self-enforcing assumption could still hold and one could aim for complete contracts, better coordinated through markets and where prices are the key variables. Nevertheless, "neoclassical contracts" (incomplete, longer term, more uncertainty and risks to parties) could be considered more a hybrid type of institutional arrangement, within the spectrum between markets and hierarchies.

Third, from the combination of these two premises the need to widen the conceptual framework and include institutions and consider the variety in contractual arrangements (within one single national system) becomes clear. The notion of contracts as institutional arrangements put forward by NIE and TCE is then adopted; together with concepts like enforcement mechanisms -formal and informal- and typologies of contracts depending on the type or nature of the transaction that needs to be coordinated.

Fourth, given the cross-national comparative nature of the research there was a need to include more institutional layers or what is called the institutional environment. The institutional environment is expected to significantly vary per country. By including additional institutional layers, all with different paces of change, the conceptual framework is also extended to include a time dimension.

Fifth, the search across time requires the adoption of theories and concepts that could handle the dynamics of change and describe the mechanisms behind the evolution of

institutions. NIE and TCE remain still "equilibrium oriented approaches", that have even though they allow for a meaningful static comparison of pros and cons of different institutional arrangements two main weaknesses. First, they do not allow for the explanation of mechanisms behind the evolution from old to new equilibria. Secondly, as institutional environments are described at such high level of aggregation; subtle institutional differences between countries are often overlooked or deemphasized and consequently in most cases they cannot account for nuanced differences in path-dependency and final equilibria reached in specific institutional (sub)systems or countries.

Consequently the conceptual framework needs to be extended even further to adopt essential notions from evolutionary economics and OIE such as path-dependency and from social sciences such as power (exerted by different stakeholders).

Road reform: the global agenda versus the national agenda

More often than not, individual countries take the sketches of models to be emulated as reference frames for how to restructure the institutions for their own road management system. One could say that among experts and policy-makers in the international arena and transfer agents carrying ideas from international organizations to the national scene and vice versa, a worldwide pool of ideas on road reform exists from which national governments can borrow.

As pointed out before, four trends seem dominant in road contracting. Britain, New Zealand and Australia are presented as leading, because they materialized most of these trends. Other countries are seen as lagging behind them, but still following largely the same developmental path, albeit slower and later. This would suggest that road reform occurs more or less uniformly around the world, with countries following the same steps.

Nevertheless, the analysis of the reform paths followed by three different countries shows that the institutional starting positions of various countries can differ so markedly that they are bound neither to follow the same developmental paths nor to produce similar institutional outcomes after the reform. Put differently, multiple institutional equilibria exist, which result from different starting positions leading through different histories of interaction between players to different institutional equilibria.

While Finland, Norway, Sweden and the Netherlands have no or little experience with funding road infrastructure through toll-levying or transferring the financial or managerial responsibility of entire projects to private parties, in Spain, Portugal, France and Italy road users are accustomed to paying for the use of infrastructure because these countries have a long-standing tradition in private or mixed entrepreneurship

and finance in road construction and maintenance. As a consequence, the reform process of liberalization, privatization, private finance and growing design freedom for contractors puts very different types of strains on these countries. The steps taken to push through the reform as the policy-makers in each of the countries defined it, also diverged.

By comparing the initial and final institutional structures, reviewing the preferences of the actors in these countries before and after the reform, and the particular reform paths they followed, it became evident that Finnish, Spanish and Dutch actors have selectively taken ideas from the worldwide pool of ideas on road reform. Their initial circumstances kept them from adopting all ideas from the worldwide agenda, at least with the same emphasis. Instead these countries have chosen the reform ideas most suitable to them. This selection process has resulted in a new institutional equilibrium in which a particular subset of ideas, for each of the countries, has been absorbed. From the three countries studied, Finland and Spain were found relatively more successful in their implementation of road reform and innovative contracting practices.

One could claim that Finland typically represents a successful example of liberalization in which direction a number of countries in Northern Europe are headed, whereas Spain can be seen as a forward-looking representative of the Latin (Southern European) model, in which the aspect of privatization comes more to the fore. The way the reform was implemented, as well as the relative advance each of them has shown in the use of innovative contracting, made evident that even though both countries have taken up the challenge of road reform, they have done so in very different ways. Surprisingly enough, both countries have become world examples and pioneers in their own right. Both can be pleased with the extent to which they realized their objectives, within the context of their own national system.

Finland has succeeded in downsizing the road agency and in creating a brand-new market for routine maintenance, and has achieved savings of up to 40 per cent. And Spain has succeeded in expanding the national transport network and updating it to meet European standards, all within the financial strictures of the European Union. The question is whether their current equilibria are sustainable. Challenges are not over yet.

In Finland the strong focus on efficiency and competition is causing cutthroat competition that threatens to affect negatively the development of the sector. Contractors may start to act in their defence and push towards a new wave of reforms. In Spain the recent developments in the use of shadow-tolls for the financing of projects are expected to create serious financial problems in the future, which may necessitate a new wave of reforms. In both cases, the current institutional equilibria may still turn out to have been sub-optimal and temporary ones.

The Dutch reform lacks a clear driver and a sense of urgency. Consequently results are difficult to judge, ranging from poor to ambiguous. The needed skills and expertise for a successful implementation of innovative contracts do not seem to be yet in place

-neither in the public nor the private sector-, market players do not seem satisfied and the contracting practices of RWS still lack uniformity. The only clear result is the reduction of the agency personnel, in fact the only operational goal set since the beginnings of the reform.

Therefore the Netherlands does have lessons to learn from pioneers as Spain and Finland. Inspiration can be found in the Spanish case on how they have succeeded on creating enough deal flow for PPP projects that offset the high transaction costs involved. Meanwhile Finland is a good example on strong (internal) agency leadership, on the management of stakeholders so to achieve consensus up-front and on keeping the implementation plan discussed with stakeholders fixed for a significant number of years even though external pressures. All in all it means that even though the differences in institutional contexts and historical developments, learning from another country it is possible. What remains unattainable is the formulation of ready-make recipes or best practices, applicable to a wide range of countries, independent of their goals or priorities.

Road Roles: exploring opportunistic behaviour and its consequence across time

Greater scope for opportunistic behaviour makes research into how contractors will react to this freedom all the more urgent. If opportunistic behaviour does take place, how far-reaching are the consequences of this behaviour for the performance of the road system? In order to investigate these and other questions, a gaming- simulation called Road Roles has been developed.

A generic version of the game was developed and after many testing sessions (with game experts and road-pavement experts), a verified and fine-tuned version has been played 14 times in the three countries being studied. Eight of these sessions have been realized with professionals and experts in the area of innovative contracting. The game exercise -developed according to gaming-simulation guidelines- has a strong game-theoretic component. Consequently, the design and resulting observations are comparable to some experiments conducted by experimental economists, except that it allows players greater freedom of decision.

Road Roles simulates the future situation in road maintenance at an abstract level. Instead of the traditional prescriptive contracts, long-term and performance-based contracts are used to provide periodic maintenance for a whole road network. Traditional contracts prescribe the kind of work that needs to be done in a specific section of the network. Performance-based contracts increase contractors' freedom to a maximum level; the contractor decides which road section, when and what kind of work he will perform, with the only condition of keeping a certain level of performance for a whole road network within a specific area or district for a certain number of years.

The simulation evolves as contractors learn to play with the selection criteria and the payment mechanisms -bonuses and penalties- in order to maximize their profits and specialize through investments in Research and Development; and as the road agency learns from the response of the contractors and refines the rules and selection criteria. The game session, consisting of 4 to 6 tendering rounds ends with a debriefing where the results of all players, contractors in terms of money and road-administration in terms of resulting road conditions, are discussed.

From the analysis of the simulation results, it appears that opportunistic behaviour plays a very substantial role during the tendering and implementation process of road maintenance reform. The role of the road authority, and especially its anticipation of contractor behaviour, its subtlety in administering specifications, and its incentives for "good" and "bad" behaviour on the part of contractors are key in averting anomalies and a decline in road quality. Many agencies, but not all, seemed to fail in this important mission during gameplay.

There are also findings with direct implications for procurement policy. Firstly, high penalties seem to create incentives for collusive behaviour, while a combination of moderate penalties with significant bonuses creates a positive atmosphere of trust. Secondly, monitoring is of key importance when effectively implementing any system of sanctions and bonuses, as it increases the expectations of contractors about the reward and punishment choices of the road authority. In other words it increases their belief in the rules of the authority. Thirdly, it proved difficult to establish a stable set of rules and to obtain exactly the results intended, as policies become less effective after being applied for a certain period. Lastly, in all game-runs a process of market concentration was observed.

Research findings

The research has resulted in the development of a lesson-drawing framework, which combines two elements. First, a comparative dynamic framework that serves as a guide for countries to evaluate if successful elements from practices elsewhere can be incorporated in their own regulatory regimes, contractual arrangements and practices. Second, a generic gaming-simulation tool that allows policy makers to experiment with different contract settings and incentives so as to arrive at the understanding needed to set the right incentives for contracts within their national institutional context.

Dealing with opportunistic behaviour

The evaluation of practical experiences of three countries and experimental results shows that the problems of information asymmetry and market concentration do play an important role in innovative contracting practices. The evidence gathered corrob-

orates the tension between the technical aspects of design freedom and the fulfilment of public values.

Interesting enforcement mechanisms being applied by national authorities and concrete ways in which they are dealing with opportunistic behaviour were discovered through the case study research. Before presenting these, however, it is important to explain that the changes brought into the national road administration system by the introduction of some of them often pose new problems or dilemmas. Those issues need further consideration if the plan is to implement these practices full scale in the future.

First, a common method used to control contractors, while granting them relatively more freedom, is the so-called "own responsibility principle". The higher penalty or deduction is often the one due to non-compliance with their own Quality Control Plan. This solution however does not solve the problem of information asymmetry, especially concerning long-term maintenance, and results in an increased dependency on external engineering consultants. The significant increase recorded in the number of external consultants working for the road authority in a variety of roles and tasks poses a new trade-off of *efficiency* versus *integrity*.

Second, the use of economic incentives and disincentives, bonuses to promote "good behaviour" and penalties to deter contractors from "bad behaviour", is being implemented more and more by national road authorities. These instruments have proved to be effective especially in achieving shorter project delivery times and increasing contractor awareness of user wishes. Nevertheless, finding an adequate balance of positive and negative rewards has proved difficult in practice. An additional challenge for the successful implementation of these and other enforcement mechanisms is posed by the fact that rules lose their effect over time. Selection criteria, requirements and incentive schemes work best the first time they are applied and lose their edge in consecutive tendering rounds. This is a pattern observed in different countries and in all gaming sessions. The low *stability of rules* is either a consequence of opportunistic behaviour or changes in external factors.

The use of innovative contracting practices

The experiences of the Dutch, Spanish and Finnish road authorities have been analysed to estimate their relative advance in the use of innovative contracting practices and the outcomes they have recorded (in terms of "improvements" in efficiency and innovation or degree to which their own expectations have been fulfilled). The main findings from this analysis indicate the following:

- The relative advance in the use of innovative contracting practices in the market of capital projects is significant. DB and/or other integrated project delivery methods represent more than 40% of the projects being tendered or have even

become the norm. This advance is also significant in the area of routine maintenance through the use of service area agreements.

- Nevertheless, the contracts used in periodic maintenance remain rather traditional and consequently the reform of this sector remains a challenge for all three countries.

- The implementation of innovative contracting arrangements has not directly resulted in larger design space or freedom granted to contractors. It has been observed that design freedom remains limited even in the most innovative projects per country.

- Although no unambiguous measures of "improvement" are available -as information about performance, total life cycle costs of assets, etc. was not gathered in the old public infrastructure management system-, and the improvements that are recorded per country are often specified in terms of own national priorities, innovative project delivery methods have proved effective in shortening project delivery times, and the service area agreements implemented for routine maintenance have resulted in savings of around 30% in the Netherlands and Finland.

- However, based on the complaints of contractors about current profit levels, the danger of cut-throat competition recognized by certain road authorities and the expected and observed process of market concentration, there is a serious concern about whether the savings recorded are only temporal and may be reversed in the future.

Design freedom and innovation

The empirical findings are alarming. Even though road authorities often claim that one of the main goals of the changes in contracting arrangements was to increase the design freedom for contractors and therefore create more room for innovation, the process of transferring the control of design decisions to contractors has been slow, especially where bridges are concerned.

The fact is that design freedom remains limited even in the most innovative projects implemented up to date. In all countries observed there are formal and regulatory obstacles for granting more design space to contractors. Besides, there are informal institutions, like the attitude towards the management of uncertainty and dealing with change requests from contractors that play a role in limiting this space, especially in Northern Europe. The design freedom granted and the flexibility that results from this kind of innovative contracts appears to be even more limited in Finland and the Netherlands, than in Spain. This may partly be due to the fact that traffic risks (i.e. market or demand related risk assumed by concessionaires when projects are financed through direct tolls) are not placed on the private participant in the application of

availability-based payment formulas but absorbed by the public client. This is often the case in Northern European countries.

As can be observed, a number of obstacles need to be overcome if innovation is to be achieved. The question is, even when greater design freedom is granted -as it is the case in certain projects where all life cycle phases are integrated- can it result in (fundamental) technological innovation? Or just in process related innovations?

New trends in opportunistic behaviour

The implementation of the new lump-sum performance-based contracts or long term service agreements, brought a change in the formal relationship between road agency and contractors (principal and agent) as it involves fulfilling new roles. Moreover, the study of particular innovative PPP projects in the three countries studied indicates that the problem faced by road authorities is no longer as simple as often described by agency theory. Within these new contracting schemes, plausible opportunistic behaviour from a contractor (agent) is not simply a matter of investing less effort in the work than is expected by the principal. The new problem no longer seems to be about delivering low or bad quality, since requirements and indicators monitored, and on which payment is conditional, are more output or outcome oriented.

Instead, the question is whether the road authority is able to negotiate or is paying the "right" or "fair" price for the quality or level of service that has been established in advance (and for the set of risks transferred to the contractor). As contracting is more than ever about proper "risk distribution" and "risk sharing", the principal is left more at a disadvantage. Not only during the realization or implementation of the work, as agency theory emphasizes, but also ex-ante, before the project has actually started. The general picture becomes blurred and it is far more difficult to determine what a fair price is. Negotiation is about risks and not purely about material or engineering aspects. Determining a fair price was definitely far easier in the past, when projects and technical solutions were calculated in terms of cubic meters of asphalt. In agency theory terms one could say that there has been a shift in importance from moral hazard to adverse selection.

It is important to highlight that in this new situation it is also difficult for contractors themselves to assign a price to certain risks and levels of reliability. A question posed by practitioners -particularly in the Netherlands where contractors perceived that too high risks are transferred and/or too high system availability levels are required- is to what extent the principal is paying for a service or placing an incentive for better performance, and to what extent he is actually paying insurance. Some of these risks may be better placed and negotiated in a different market -such as the insurance market as contractors themselves may not (yet) be able to actually control these risks. The government may be better off assuming some of these risks directly and/or requiring somewhat lower levels of system availability.

Alternatively, government authorities with a history of payments of too high prices

to contractors often react by tendering similar contracts for considerably lower budgets in the future. Here a new problem emerges. Contractors, urged to avoid the high costs of idle capacity, may accept to take part in the tendering even when it is clear to them that profit margins are slim or they may actually make a loss. This endangers the development of the sector. Or they may submit offers even below their costs, hoping to recover the losses in the future either through renegotiation or by engaging in legal claims. It has been observed in all game sessions that in this new system the most successful contractors are those who adapt faster and read precisely and literally the new terms of the invitation to tender (i.e. deducing future bonus from their price and/or anticipating gains they may extract by exploiting the weak spots of the contract). Meanwhile, the less successful are the ones that stick to calculating their bids based on the traditional way based on total costs plus profit margin. In practice smaller contractors tend to be the ones having more difficulty to adapt to the new ways of calculating prices for their offers.

The truth is that either way, whether the authority or the contractor is the loser of the game, both deals are suboptimal from a societal point of view because either quasi monopoly rents are paid from taxpayers' money, or the future of the private sector is put in danger, while often unproductive legal costs must be born by both parties. The role of the authority as a guardian of public values and public finances is nowadays more challenging than ever. In the new contracting setting versus the traditional one, opportunistic contractor behaviour plays a larger part not only prior to contract closing but also afterwards, as these new contracts leave ample space for future contract renegotiations or legal battles.

Innovative contracts by their very nature are bound to remain incomplete, thus increasing the possibility of, or the need for, renegotiations of contract terms in the future and requiring a different set of strategies to mitigate opportunistic behaviour. Three major differences between traditional and innovative contracts that explain the root of this new problem are:

1. New contracts use a different incentive scheme. Innovative contracts are often fixed-price contracts or so-called lump-sum contracts, under which the winning firm is residual claimant for its cost savings. The road authority does not de facto reimburse any of the costs; it pays only a fixed fee; the contractor runs almost all project risks.

2. The item being contracted is no longer a physical "product" or delivery of a physical asset or facility, but a "service" and moreover, the availability of such service for an x number of years.

3. Contract terms of this new type of contracts are often longer, from 3 or 5 to up to 30 years or more.

All three points above only mean a significantly higher amount of risks being transferred to the private sector, for which a fair price has to be negotiated up-front. Innovative contracts also mark the beginning of a new attitude or way of managing contractors at a distance, which means that public authorities in their role of clients have less possibilities and authority to influence the process or steer contractors directly in a particular preferred direction. Thus again, many more aspects need to be decided up-front than in traditional contracts.

To summarize, road authorities in their new role of quality regulators, or at most network operators, have to find new ways of dealing with new types of opportunistic behaviour; while accepting the possible costs of initial failures as part of the learning process towards a new equilibrium. But patience and acceptance of failures as necessary investment are not enough to ensure success. Significant savings in time and money could be achieved if proper investments in training of personnel at all levels -procurement directors, contract managers and engineers formulating requirements- are realized and effort is invested in anticipating the weaknesses of future contracts and their formulation.

Further research

Further research and development of training tools that support public authorities in the successful implementation and management of innovative contracts and their dynamics are urgently required to prevent public values being compromised and society paying far too much as part of the learning process.

Gaming and other simulation techniques offer a great opportunity in this respect, as they allow practitioners to learn from their mistakes without carrying the costs of real life failures. The first step towards success is to create understanding across the whole organization that these new procurement practices require a very different attitude and set of skills; and an awareness of public servants and contractors that they are dealing or about to deal with problems of a different and more dynamic nature.

Mónica A. Altamirano

Samenvatting

Innovatieve contractvormen in de wegenbouw:
Cross-nationale lessen in het omgaan met opportunistisch gedrag

Probleembeschrijving en onderzoeksopzet

In de afgelopen vijftien tot twintig jaar heeft de wereld een proliferatie gezien van innovatieve benaderingen voor de levering en de financiering van openbare diensten, als onderdeel van een groeiende interesse in de private sector. Deze belangstelling heeft een belangrijke rol gespeeld bij de aanbesteding van publieke infrastructuur zoals wegen, spoor, water en gebouwen, en in het gebruik van publiek-private samenwerking (PPS) als project realisatie methode. PPS-projecten vertegenwoordigen meer dan een biljoen dollar aan investeringen in de geplande of voltooide infrastructuurprojecten wereldwijd sinds 1985.

De verschuiving naar marktwerking begon in de Verenigde Staten in de jaren 70, met de deregulering van het spoorvervoer, de energiesector en de telecomsector. In het midden van de jaren 80 hebben Spanje, Chili, Nieuw-Zeeland en, het meest actief, het Verenigd Koninkrijk, de portefeuille uitgebreid met nieuwe afspraken die de verdeling van risico's voor de levering van openbare infrastructuurprojecten en diensten omvatten.

Sinds de late jaren 80, zijn in diverse landen over de hele wereld PPS-projecten naar voren gekomen inzake de levering van infrastructuur. In de transportsector is deze ontwikkeling samen gegaan met een opleving van de belangstelling voor het oude concessiemodel van tolwegen, een model waarvoor men gedurende vele jaren geen voorkeur had. In alle sectoren en de meeste landen wereldwijd is de groeiende belangstelling voor PPS benaderingen of het zoeken naar alternatieve financierings- en leveringsmethoden voornamelijk veroorzaakt door de toenemende kloof tussen de eisen die gesteld worden aan de financiering van infrastructuur en de inkomsten. PPS wordt gezien als een manier om de aanleg van kritieke infrastructuur te bespoedigen die anders niet zou worden gebouwd. Ze worden in toenemende mate aantrekkelijk voor overheden die financiële discipline nastreven, aangezien ze openbare instanties

in staat stellen om deze nieuwe voorzieningen te leveren door gebruik te maken van de financieringsmiddelen van de private sector, zonder, anders onvermijdelijke, openbare schuld aan te gaan.

Meer dan een derde van de geplande publiek infrastructuur (wegen, spoor, water en gebouwen) sinds 1985, of voltooid voor oktober 2008, betroffen wegprojecten, met inbegrip van snelwegen, bruggen en tunnels. Europa heeft het grootste PPS-infrastructuurprogramma in termen van wegen- en spoorwegen projectkosten. Het Europese wegenprogramma bedraagt $ 298,9 ($ 136) miljard tegenover $ 91,6 ($ 56,3) miljard van het Latijns-Amerikaanse wegenprogramma. De term PPS wordt vaak gebruikt door autoriteiten om te verwijzen naar projectrealisatiemethoden waarbij private financiering van infrastructuur voor een lange termijn een rol speelt, zoals Design-Build-Finance-Maintain (DBFM) projecten of concessies. Echter, in bredere zin omvat de term PPS een ruime verscheidenheid aan financierings- en leveringsbenaderingen van projecten. PPS-projecten kunnen een breed scala aan verantwoordelijkheden en risico's omvatten voor de publieke en private partners. De aard en omvang van de private sector in PPS-projecten kunnen variëren van lange-termijn dienstverleningscontracten tot volledige financiering, exploitatie en onderhoud, waarbij de private sector een toenemende verantwoordelijkheid neemt voor verschillende functies uit de hele levenscyclus van infrastructuur, zoals Manage, Design, Build, Operate, Maintain, Finance en/of zelfs Own.

De overdracht van risico en verantwoordelijkheid naar de particuliere aannemer gaat natuurlijkerwijs hand in hand met een delegatie van de controle, de overdracht van aanvullende beslissingsrechten om te bepalen hoe het project of taak zal worden voltooid. Als gevolg van deze twee kenmerken, de overdracht van risico's en van beslissingsrechten, brengt het potentieel van PPS ook een aantal uitdagingen met zich mee daar de complexiteit van de regelgeving en het beheer van dergelijke contracten alleen maar toeneemt.

De complexiteit en de moeilijkheidsgraad van het opstellen van goede contracten blijkt uit de grote verschillen in de resultaten die door verschillende landen zijn behaald. Vooral met betrekking tot particuliere financieringsinitiatieven zijn indrukwekkende resultaten geboekt door landen als Australië en Chili. Ondertussen werd het wegconcessieprogramma van de jaren 90 van Mexico bekend om zijn katastrofale resultaten, daar deze resulteerde in een massale financiële reddingsoperatie door de overheid.

De moeilijkste taak is het komen tot een evenwichtige en aanvaardbare verdeling van verantwoordelijkheden, risico's en beloningen samen met de particuliere sector. Verwachtingen van overheden van de te bereiken besparingen door middel van innovatieve contractvormen hebben in veel gevallen geresulteerd in bevooroordeeld optimisme aan beide zijden. Het probleem is, dat in veel gevallen het resultaat van overdreven optimisme heronderhandeling is. Onrealistische en agressieve biedingen leiden tot heronderhandeling voor een groot aantal projecten.

Het is een uitdaging om een PPS-project met succes af te ronden. Een doeltreffend ontwerp van de overeenkomst vóór de start van het project is van cruciaal belang, want vaak is er weinig meer dat een overheidsinstantie kan doen dan ervoor te zorgen dat alle betrokken partijen voldoen aan hun contractuele verplichtingen.

Vier trends kunnen worden waargenomen in de aanbesteding van wegen. Ten eerste projecten die zijn aangegaan voor de gehele levenscyclus van de weg. Ten tweede krijgen aannemers steeds meer ontwerpvrijheid, doordat de indicatoren voor het toezicht op hun werk minder operationeel- en meer prestatie-gericht worden. Ten derde worden meer projecten gefinancierd door particuliere investeerders. Ten vierde worden de contracten steeds vaker toegekend voor de langere termijn.

Pas in de laatste 15 jaar zijn deze alternatieve project-realisatiemodellen of aanbestedingsregelingen gebruikt of getest voor de aanleg van wegeninfrastructuur. Voorafgaand aan de recente hervormingen in de wegenbouw over de hele wereld, volgden de meeste overheden het zogenaamde traditionele aanbestedingsmodel. Exploitatie en onderhoudstaken werden voornamelijk gerealiseerd door het eigen personeel van de wegenbeheerder en infrastructurele projecten werden rechtstreeks gefinancierd met publieke middelen. Outsourcing vond plaats op een adhoc basis.

De verwachtingen zijn hoog: meer flexibiliteit in de wegenbouw sector, meer innovatie, betere prestaties en dus lagere kosten, terwijl het niveau van dienstverlening en publieke waarden, zoals mobiliteit, veiligheid en het milieu, worden gehandhaafd. Maar hoe succesvol zijn wegbeheerders geweest in de implementatie van dergelijke innovatieve regelingen in de praktijk? En hoe kunnen de verwachte positieve resultaten daadwerkelijk worden bereikt? Zijn er mogelijke spanningen tussen de aspecten van contract flexibiliteit en die van publieke waarden?

De geïmplementeerde maatregelen om flexibiliteit van de contracten te verruimen en aanvullende beslissingsrechten toe te kennen aan aannemers kunnen in feite het probleem van informatie-asymmetrie tussen beheerder en aannemers vergroten, omdat aannemers waarschijnlijk meer prive-informatie onthouden aan de wegbeheerder. Dit informatieve voordeel biedt aannemers meer mogelijkheden en ruimte voor opportunistisch handelen, uiteindelijk ten koste van de staat van het netwerk, een bedreiging vormend voor de vervulling van publieke waarden (zoals beschikbaarheid, toegankelijkheid, veiligheid en betaalbaarheid).

Daarom kan het meest uitdagende probleem waarmee de nationale beheerders van wegeninfrastructuur, evenals vele andere beheerders van netwerkgebonden infrastructuren, de afgelopen decennia geconfronteerd zijn, worden geformuleerd als een tradeoff: *Hoe de verwachte positieve resultaten van innovatieve aanbesteding -vooral verbeteringen in efficiëntie en innovatie- te bereiken, terwijl de ruimte voor opportunistisch gedrag (van de kant van aannemers) en de (negatieve) effecten zo minimaal mogelijk gehouden worden?*

De huidige studie heeft tot doel om deze vraag te beantwoorden door te onderzoeken of en hoe de verschillende landen en hun nationale wegbeheerders oplossingen hebben

gevonden voor dit probleem en om lessen te trekken voor wegbeheerders over de hele wereld.

Het onderzoek is ontworpen bestaande uit twee hoofdelementen, een cross-nationaal vergelijkend onderzoek van de aanbestedingspraktijken en een spelsimulatietool.

Het eerste element van het onderzoek is een cross-nationaal vergelijkend onderzoek opgezet als een meervoudige casestudie met daarin opgenomen analyse-eenheden. De belangrijkste analyse-eenheid is de nationale inkoopstrategie met al zijn componenten. De daarin opgenomen analyse-eenheden zijn projecten, bij voorkeur Publiek Private Samenwerkingsprojecten (PPS), die dergelijke innovatieve aanbestedingspraktijken omvatten.

De historische opsomming van nationale hervorming en inkoopmodellen, gerealiseerd door middel van casestudie-onderzoek, wordt aangevuld met een spelsimulatie-instrument, "Road Roles", om lange-termijn effecten te onderzoeken van toekomstige scenario's in innovatieve contracten, met name voor het geval van periodiek wegenonderhoud, waar fundamentele hervormingen worden verwacht.

De theoretische basis van dit onderzoeksproject combineert economie (agency-theorie, nieuwe institutionele economie, oude institutionele economie en andere evolutionaire theorieën) met ontwerptheorie. Voorts omvatten de methodieken die de ontwikkeling van een case study protocol, een generiek instrument (spel-simulatie) en de analyse van de verzamelde empirische gegevens ondersteunen systeem analyse (systeem dynamica), stakeholder analyse, casestudie-onderzoek en spel-simulatie.

Dynamisch vergelijkend kader van nationale aanbestedingsmodellen

De ontwikkeling van een onderzoeksstrategie heeft een proces van continue verrijking van het conceptuele kader betekend met concepten en aannamen aangenomen vanuit verschillende theoretische invalshoeken. De belangrijkste stappen genomen in dit proces alsook de bijdrage van elk van deze theorieën aan de analyse van aanbestedingspraktijken volgen.

Ten eerste wordt agency-theorie gebruikt in combinatie van een aantal concepten uit ontwerptheorie bij een eerste analyse van het probleem en het systeem. In overeenstemming met aannamen uit agency-theorie worden contracten in deze eerste analyse beschouwd als zichzelfhandhavend, gesloten systeem of zelfomvattend, zonder rekening te houden met de invloed van instituties.

Ten tweede, uit deze eerste formele analyse blijkt dat de implementatie van innovatieve wegaanbestedingspraktijken (langere termijn, overdracht van risico's en grotere onzekerheid) een overgang betekent van "klassieke contracten" naar "neo-klassieke contracten". Agency-theorie is eerder van toepassing op klassieke contracten, waar de zichzelfhandhavende aanname nog steeds geldt en waar men zich kan richten op complete contracten, beter gecoördineerd door de markt en waar de prijs de voornaamste

variabele is. Echter kunnen neo-klassieke contracten (incompleet, langere termijn, meer onzekerheid en risico voor de partijen) worden beschouwd als een meer hybride type van een institutionele overeenkomst, zich bevindend in het spectrum tussen markten en hierarchieën.

Ten derde, uit de combinatie van deze twee vooronderstellingen blijkt de noodzaak om het conceptuele kader uit te breiden en instituties toe te voegen en de verscheidenheid aan contractuele overeenkomsten te beschouwen (binnen één nationaal systeem). Het concept van contracten als institutionele overeenkomsten naar voren gebracht door NIE en TCE wordt vervolgens overgenomen; samen met concepten als handhavingsmechanismen -formeel en informeel- en de typologie van contracten afhankelijk van het type of de strekking van de transactie die moet worden gecoördineerd.

Ten vierde, gegeven het cross-nationale vergelijkende karakter van het onderzoek is er een noodzaak om meer institutionele lagen, ook wel de institutionele omgeving genoemd, toe te voegen. Het wordt verwacht dat de institutionele omgeving substantieel varieert van land tot land. Door extra institutionele lagen toe te voegen, ieder met een ander tempo van verandering, wordt het conceptuele kader tevens uitgebreid met een tijdsdimensie.

Ten vijfde, uitbreiding naar tijdsdimensie vereist het gebruik van theorieën en concepten die om kunnen gaan met de dynamica van verandering en die het mechanisme achter de evolutie van instituties kunnen beschrijven. NIE en TCE blijven "evenwicht georienteerde aanpakken", die hoewel ze een betekenisvolle statische vergelijking van voors en tegens toelaten van veschillende institutionele overeenkomsten twee grote zwakheden hebben. Ten eerste staan ze niet de uitleg toe van mechanismen achter de evolutie van oude naar nieuwe evenwichten. Ten tweede, wanneer institutionele omgevingen op een dergelijk hoog niveau van aggregatie worden beschreven, worden subtiele institutionele verschillen tussen landen vaak over het hoofd gezien of minder belangrijk gemaakt, waardoor in de meeste gevallen ze geen rekening houden voor genuanceerde verschillen in padafhankelijkheid en het uiteindelijke evenwicht dat wordt bereikt in specifieke institutionele (sub)systemen of landen.

Het gevolg is dat het conceptuele kader nog verder uitgebreid dient te worden om essentiële concepten uit evolutionaire economie en OIE te omvatten, zoals padafhankelijkheid, en uit sociale wetenschappen, zoals macht (uitgeoefend door verschillende stakeholders).

Road reform: de mondiale agenda versus de nationale agenda

In veel gevallen nemen individuele landen vage schetsen van modellen om geëmuleerd te worden als referentiekaders voor hoe de instituties voor hun eigen wegbeheersystemen hergestructureerd dienen te worden. Onder experts en beleidsmakers in de

internationale arena en transfer agenten die ideeën overbrengen van internationale organisaties naar de nationale omgeving en vice versa bestaat een wereldwijde pool van ideeën waaruit nationale overheden kunnen lenen.

Zoals eerder omschreven lijken vier trends dominant in aanbestedingen in de wegenbouw. Groot-Brittannië, Nieuw Zeeland en Australië worden gepresenteerd als toonaangevend, omdat zij de meeste van deze trends verwezenlijkt hebben. Andere landen worden gezien als achterblijvend, maar nog steeds hetzelfde ontwikkelingspad volgend hoewel later en langzamer. Dit zou suggereren dat hervorming van de wegenbouwsector min of meer uniform over de wereld plaatsvindt, met landen die dezelfde stappen doorlopen.

Desalniettemin, laat de analyse van hervormingspaden gevolgd bij drie verschillende landen zien dat de instutionele startposities van verschillende landen zo ver kan verschillen dat zij gedwongen zijn om niet hetzelfde ontwikkelingspad te doorlopen en ook niet om dezelfde institutionele resultaten te laten zien na de hervorming. Anders gezegd, er bestaan verschillende institutionele evenwichten welke het resultaat zijn van verschillende startposities leidend via verschillende geschiedenissen van interactie tussen spelers naar verschillende institutionele evenwichten.

Terwijl Finland, Noorwegen, Zweden en Nederland weinig of geen ervaring hebben met het financieren van weginfrastructuur via tolheffen of het overdragen van financiële en management verantwoordelijkheden van hele projecten naar private partijen, zijn weggebruikers in Spanje, Portugal, Frankrijk en Italië gewend aan het betalen voor het gebruik van infrastructuur omdat deze landen een omvangrijke traditie hebben in het private en gemengde ondernemerschap en financiering van wegenbouw en onderhoud. Het gevolg is dat het hervorming proces van liberalisering, privatisering, private financiering en de groeiende ontwerpvrijheid verschillende vormen van spanning op deze landen legt. De genomen stappen om het hervormingsproces door te drukken zoals gedefinieerd door de beleidsmakers in elk van de landen waren dan ook uiteenlopend.

Door de initiële en de uiteindelijke institutionele structuren te vergelijken, door het bestuderen van de voorkeuren van de actoren in deze landen voor en na de hervorming en de typische hervormingspaden die gevolgd zijn, werd het evident dat de Finse, Spaanse en Nederlandse actoren afzonderlijk van elkaar ideeën overgenomen uit de wereldwijde pool van ideeën over wegenbouwhervorming. Hun initiële omstandigheden weerhield hun ervan om alle ideeën uit de wereldwijde agenda over te nemen, ten minste met dezelfde accenten. In plaats daarvan hebben deze landen de hervormingsideeën overgenomen dat het meest geschikt waren voor hen. Dit selectieproces heeft geresulteerd in een nieuw institutioneel evenwicht waarin een bepaalde sub-set van ideeën voor elk van de landen opgenomen is. Uit de drie onderzochte landen werden Finland en Spanje relatief meer succesvol bevonden in hun implementatie van hervorming van de wegenbouw en innovatieve aanbestedingspraktijken.

Finland zou kunnen worden gezien als een succesvol voorbeeld van liberalisering ver-

tegenwoordigd in de richting waar een aantal Noord-Europese landen zich bewegen, terwijl Spanje gezien kan worden als een vooruitstrevende vertegenwoordiger van het Zuid-Europese model, waar het aspect van privatsering meer naar voren komt. De manier waarop de hervorming geïmplementeerd is alsmede de relatieve vordering die elk van hen laat zien in het gebruik van innovatieve aanbesteding, maakt het evident dat hoewel beide landen de uitdaging van hervorming in de wegenbouw aangegaan zijn, dat ze dit in zeer verschillende manieren hebben gedaan. Verrassend genoeg zijn beide landen voorbeelden en pioneers geworden op hun eigen wijze. Beiden kunnen tevreden zijn met de omvang waarmee zij hun doelen gerealiseerd hebben, binnen de context van hun eigen nationale systeem.

Finland is erin geslaagd om de wegbeheerorganisatie in te krimpen en in het creëren van een volledig nieuwe markt voor wegenonderhoud, waarmee besparingen tot 40 procent gerealiseerd zijn. Spanje heeft kans gezien om het nationale transport netwerk uit te breiden en te upgraden naar Europese normen, dit allemaal binnen de financiële grenzen van de Europese Unie. De vraag is of hun huidige evenwichten duurzaam zijn. Uitdagingen zijn nog niet over.

In Finland resulteert de sterke focus voor efficiëntie en concurrentie in een moordende concurrentie die de ontwikkeling van sector negatief dreigt te beïnvloeden. Aannemers zouden defensief kunnen gaan handelen en een impuls kunnen geven naar een nieuwe golf van hervormingen. In Spanje wordt verwacht dat de recente ontwikkelingen in het gebruik van schaduwtol voor financiering van projecten ernstige financiële problemen kunnen veroorzaken in de toekomst, hetgeen een nieuwe golf van hervormingen noodzakelijk zou kunnen maken. In beide gevallen zou het huidige institutionele evenwicht nog steed sub-optimaal en tijdelijk kunnen blijken.

De Nederlandse hervorming mist een duidelijke drijfveer en een gevoel van urgentie. Hierdoor zijn resultaten moeilijk te beoordelen, en lopen uiteen van zwak tot dubbelzinnig. De noodzakelijke vaardigheden en expertise voor een succesvolle implementatie van innovatieve contracten lijken er nog niet te zijn -zowel in de publieke als de private sector-, markt spelers lijken niet tevreden en aanbestedingspraktijken van RWS vertonen nog steeds gebrek aan uniformiteit. Het enige duidelijke resultaat is de reductie van personeel van de wegbeheerder, feitelijk het enige operationele doel sinds het begin van de hervorming.

Derhalve heeft Nederland lessen te leren van pioneers als Spanje en Finland. Inspiratie kan worden gevonden in het geval van Spanje hoe zij erin geslaagd zijn om voldoende deal flow te genereren voor PPS projecten die de resulterende hoge transactiekosten compenseren. Ondertussen is Finland een goed voorbeeld van sterke (intern) leiderschap van de wegbeheerder, van omgang met stakeholders om vooraf consensus te bereiken and van het vasthouden aan het implementatie plan overlegd met stakeholders voor een aanzienlijk aantal jaren ondanks externe druk. Al met al betekent dit dat hoewel er verschillen zitten in de institutionele context en historische ontwikkeling, het leren van andere landen mogelijk is. Wat onmogelijk blijft, is de formulering van kant-en-klare recepten of "best practices" die van toepassing zijn op een grote

verscheidenheid aan landen, onafhankelijk van hun doelen of prioriteiten.

Road Roles: verkenning van opportunistisch gedrag en haar gevolg in de tijd

Meer ruimte voor opportunisiisch gedrag maakt onderzoek naar hoe aannemers zullen reageren des te urgenter. Indien opportunistisch gedrag plaatsvindt, hoe ver reiken dan de gevolgen van dit gedrag voor de prestaties van het wegensysteem? Om deze te onderzoeken alsmede andere vragen is een spelsimulatie genaamd Road Roles ontwikkeld.

A generieke versie van het spel is ontwikkeld en na vele testsessies (met gaming experts en met experts uit de wegenbouw), is een geverifieerde en ge-fine-tunede versie 14 keer gespeeld in de drie bestudeerde landen. Acht van deze sessies zijn uitgevoerd met professionals en experts op het gebied van innovatieve aanbesteding. De speluitoefening -ontwikkeld aan de hand van gaming-simulatie richtlijnen- heeft een sterke gaming-theoretische component. Dientengevolge zijn het ontwerp en de resulterende observaties vergelijkbaar met een aantal experimenten uitgevoerd door experimentele economen, behalve dat het de speler een grotere keuzevrijheid biedt.

Road Roles simuleert de toekomstige situatie in het wegenonderhoud op een abstract niveau. In plaats van traditionele voorschrijvende contracten worden lange termijn en prestatie-gerichte contracten gebruikt om te zorgen voor periodiek onderhoud voor een geheel wegennet. Traditionele contracten schrijven het soort werk voor dat uitgevoerd dient te worden in een bepaald deel van het net. Prestatie-gerichte contracten verhogen de vrijheid van de aannemer naar een maximum niveau; de aannemer besluit welk stuk weg, wanneer en welk soort werk uitgevoerd wordt, met als enige voorwaarde dat een bepaald prestatieniveau gehandhaafd wordt voor geheel wegnetwerk in een specifiek gebied gedurende een aantal jaren.

De simulatie ontwikkelt naarmate de aannemers leren te spelen met selectie criteria en betalingsmechanismen -bonussen en boetes- zodat zij hun winst maximaliseren en specialiseren door middel van investeringen in Research en Development; en naarmate de wegbeheerder leert van de reactie van de aannemers en de regels en selectie criteria verfijnt. De spelsessie, bestaande uit vier tot zes aanbestedingsronden eindigt met een korte debriefing waar de resultaten van alle spelers worden besproken, aannemers in termen van geld en wegbeheerder in termen van resulterende wegconditie.

Uit de analyse van de simulatie resultaten blijkt dat opportunistisch gedrag een substantiële rol speelt gedurende het aanbestedings- en implementatieproces van de hervorming van het wegenonderhoud. De rol van de wegbeheerder, en voornamelijk zijn anticipatie van het gedrag van de aannemer, zijn subtiliteit in het voorschrijven van specificaties en de prikkels die van hem uitgaan om "goed" of "slecht" gedrag van de

aannemers te stimuleren zijn van essentieel belang om afwijkingen en achteruitgang van de kwaliteit van de wegen te voorkomen. Veel wegbeheerders, hoewel niet alle, leken niet in deze belangrijke missie te slagen gedurende het spel.

Er zijn ook bevindingen met directe implicaties voor het aanbestedingsbeleid. Ten eerste lijken hoge boetes een drijfveer te zijn voor heimelijk gedrag, terwijl een combinatie van gematigde boetes met substantiële bonussen een positieve atmosfeer van vertrouwen creëert. Ten tweede is controle van essentieel belang om effectief een systeem van sancties en bonussen te implementeren, daar dit de verwachtingen van aannemers vergroot betreffende de keuzes van de wegbeheerder inzake de beloning en bestraffing. Met andere woorden, het vergroot hun geloof in de regels van de wegbeheerder. Ten derde bleek het lastig om een stabiele set van regels in te stellen en om precies de beoogde resultaten te bereiken, daar beleidsmaatregelen minder effectief worden naarmate ze voor langere tijd toegepast worden. Tenslotte werd in alle spelsimulaties een proces van marktconcentratie waargenomen.

Onderzoeksbevindingen

Het onderzoek heeft geresulteerd in de ontwikkeling van een kader voor het trekken van lessen dat twee elementen combineert. Ten eerste een vergelijkend dynamisch kader dat fungeert als een leidraad voor landen om te evaluaren of succesvolle elementen van praktijken die ergens anders toegepast worden, opgenomen kunnen worden in hun eigen regelgeving, contractuele regelingen en praktijken. Ten tweede een generiek spelsimulatieinstrument die beleidsmakers in staat stelt te experimenteren met verschillende contractuele instellingen en prikkels om het noodzakelijke begrip te verkrijgen om de juiste prikkels op te nemen in contracten binnen hun eigen nationale context.

Omgaan met opportunistisch gedrag

De evaluatie van de praktijkervaringen binnen drie landen en van experimentele resultaten laat zien dat de problematiek van informatie-asymmetrie en markt concentratie een belangrijke rol speelt in innovatieve aanbestedingspraktijken. Het verzamelde bewijs bevestigt de spanning tussen de technische aspecten van ontwerpvrijheid en de vervulling van publieke waarden.

Door middel van het casestudie onderzoek zijn interessante handhavingsmechanismen toegepast door nationale overheden en concrete manieren waarmee zij omgaan met opportunistisch gedrag gevonden. Alvorens deze te presenteren, is het echter belangrijk om uit te leggen dat door de veranderingen die in het nationale wegenbeheersysteem aangebracht zijn door de introductie van een aantal van hen vaak nieuwe problemen en dilemma's vormen. Die kwesties moeten nader worden bestudeerd als het plan is om deze praktijken op volle schaal te implementeren in de toekomst.

Ten eerste, een veel toegepaste methode om aannemers te controleren, terwijl zij relatief meer vrijheid toegekend krijgen, is het "eigen verantwoordelijkheidsprincipe". De hogere boete of aftrek is meestal degene als gevolg van niet-naleving van hun eigen Kwaliteits Controle Plan. Deze oplossing lost echter niet het probleem op van informatie-asymmetrie, vooral met betrekking tot lange termijn onderhoud, en resulteert in een toegenomen afhankelijkheid van externe engineering consultants. De substantiële toename van het aantal externe consultants werkend voor de wegbeheerder in een verscheidendheid van rollen en taken vormt een nieuwe trade-off van *efficiëntie* versus *integriteit*.

Ten tweede wordt het gebruik van economische prikkels en belemmeringen, bonussen om "goed gedrag" te bevorderen en boetes om "slecht gedrag" bij aannemers te verhinderen, meer en meer toegepast door nationale wegbeheerders. Van deze instrumenten is het bewezen day zij effectief zijn voornamelijk in het bereiken van kortere oplevertermijnen en het verhogen van bewustzijn van aannemers met betrekking tot de wensen van gebruikers. Desalniettemin, is het vinden van een adequate balans tussen positieve en negatieve beloningen in praktijk zeer lastig gebleken. Een extra uitdaging bij de succesvolle implementatie van deze en andere handhavingsmechanismen wordt gevormd door het feit dat regels naarmate tijd verstrijkt hun effect verliezen. Selectiecriteria, eisen en stimulerende regelingen werken het beste zodra zij geïmplementeerd zijn en verliezen hun effectiviteit in de daarop volgende aanbestedingsrondes. Dit patroon wordt waargenomen in verschillende landen en in alle spelsessies. De beperkte *stabiliteit in de regelgeving* is of een consequentie van opportunistisch gedrag of van verandering in externe factoren.

Het gebruik van innovatieve aanbestedingspraktijken

De ervaringen van de Nederlandse, Spaanse en Finse wegbeheerders zijn bestudeerd om hun relatieve vordering in het gebruik van innovatieve aanbestedingspraktijken vast te stellen, alsmede de resultaten die zij hebben gerealiseerd (in termen van "verbeteringen" in efficiëntie en innovatie of de mate waarin zij hebben voldaan aan hun eigen verwachtingen). Uit de belangrijkste bevindingen van deze analyse blijkt het volgende:

- De relative vordering in het gebruik van innovatieve aanbestedingspraktijken in de markt van de wegenaanleg is substantieel. DB en/of andere geïntegreerde projectrealisatiemethoden omvatten meer dan 40 % van de aanbestede projecten of zijn zelfs de norm geworden. Deze voortgang is ook omvangrijk op het gebied van routineonderhoud door middel van gebruik van dienstverleningsovereenkomsten voor een specifiek gebied.

- Desondanks blijven contracten die worden toegepast op het gebied van periodiek onderhoud veeleer traditioneel en dientengevolge blijft de hervorming van deze sector een uitdaging voor alle drie landen.

- De implementatie van innovatieve aanbestedingsregelingen heeft niet direct geresulteerd in een grotere ontwerpruimte of -vrijheid die wordt toegekend aan aannemers. Waargenomen wordt, dat de ontwerpvrijheid beperkt blijft zelfs in de meeste innovatieve projecten per land.

- Hoewel geen ondubbelzinnige maat voor "verbetering" beschikbaar is -daar informatie betreffende prestatie, totale levenscycluskosten of activa, enzovoorts niet werd verzameld in het oude publieke infrastructuur managementsysteem-, en de verbeteringen die gerealiseerd zijn per land worden vaak gespecificeerd afhankelijk van de eigen nationale prioriteiten, hebben innovatieve projectrealisatie methoden bewezen effectief te zijn in het verkorten van oplevertermijnen, en de gebiedsgebonden dienstverleningsovereenkomsten uitgevoerd voor routineonderhoud hebben geleid tot besparingen rond de 30 % in Nederland en Finland.

- Echter, gebaseerd op de klachten van aannemers betreffende huidige winstniveaus, het gevaar van moordende competitie herkend door bepaalde wegbeheerders en het verwachte en waargenomen proces van marktconcentratie, is er een ernstige bezorgdheid dat de gerealiseerde besparingen alleen tijdelijk zijn en zouden kunnen verdwijnen in de toekomst.

Ontwerpvrijheid en innovatie

De empirische bevindingen zijn alarmerend. Hoewel wegbeheerders vaak claimen dat één van de hoofddoelen van de veranderingen in de aanbestedingsregelingen een toename van de ontwerpvrijheid voor aannemers en daarmee meer ruimte voor innovatie was, is het proces van de overdracht van controle en ontwerpbeslissingen naar aannemers langzaaam verlopen, vooral wanneer de aanleg van bruggen beschouwd wordt.

Feit is dat de ontwerpvrijheid zelfs in de huidige meest innovatieve projecten beperkt blijft. In alle bestudeerde landen zijn er formele obstakels en belemmeringen in de regelgeving voor het verlenen van meer ontwerpruimte aan aannemers. Bovendien zijn er formele instituties, zoals de houding tegenover het omgaan met onzekerheid en met verzoeken voor veranderingen van aannemers, die een rol spelen in de beperking van deze ontwerpruimte, in het bijzonder in Noord-Europa. De toegekende ontwerpvrijheid en de flexibiliteit die het gevolg is van dit soort innovatieve contracten lijkt nog beperkter te zijn in Finland en Nederland dan in Spanje. Dit zou gedeeltelijk kunnen komen door het feit dat verkeersrisico's (m.a.w. markt of vraaggerelateerd risico aangenomen door de concessiehouders wanneer de projecten worden gefinancierd door middel van directe tolgelden) niet gelegd worden bij de private participant bij de toepassing van beschikbaarheid-gebaseerde betalingsformules maar worden geabsorbeerd door de publieke klant. Dit is vaak het geval in Noord-Europese landen.

Zoals waargenomen kan worden, moet een aantal hindernissen overwonnen te worden indien innovatie bereikt dient te worden. De vraag is of indien een zelfs grotere ontwerpvrijheid toegestaan wordt -zoals het geval is in bepaalde projecten waar alle levencycluskosten zijn geïntregreerd- dit zou kunnen leiden tot (fundamentele) technologische innovatie of slechts tot proces-gerelateerde innovaties.

Nieuwe trends in opportunistisch gedrag

De invoering van de nieuwe lump-sum prestatie-gerichte contracten of lange termijn dienstverleningsovereenkomsten heeft een verandering gebracht in de formele relatie tussen wegbeheerder en aannemers (principaal en agent) omdat het gaat om de vervulling van nieuwe rollen. Bovendien wijst de analyse van specifieke innovatieve PPS projecten in de drie beschouwde landen erop dat het probleem van wegbeheerders niet langer zo eenvoudig is als vaak beschreven door agency theorie. Binnen deze nieuwe aanbestedingsregelingen is aannemelijk opportunistisch gedrag van een aannemer (agent) niet meer eenvoudigweg een kwestie van minder inspanning investeren in het werk dan verwacht wordt door de principaal. Het nieuwe probleem lijkt niet langer het leveren van lage of slechte kwaliteit te betreffen, daar eisen en indicatoren die gemonitord worden, en waarop betaling voorwaardelijk is, meer output en resultaat gericht zijn.

In plaats daarvan is de vraag of de wegbeheerder in staat is om te onderhandelen over de prijs of de "juiste" of "eerlijke" prijs betaalt voor de kwaliteit of dienstverleningsniveau dat van te voren is vastgesteld (en voor de risico's die overgedragen zijn aan de aannemer). Omdat aanbesteding meer dan ooit over de juiste "risicoverdeling" en "risicodeling" gaat, is de principaal meer in het nadeel. Niet alleen gedurende de realisatie of implementatie van het werk, zoals benadrukt wordt door agency theorie, maar ook ex-ante, voordat het project daadwerkelijk gestart is. Het algemene beeld wordt wazig en het is veel moeilijker om vast te stellen wat een eerlijke prijs is. Onderhandeling gaat over risico's en niet uitsluitend over materiaal of technische aspecten. In het verleden was het veel gemakkelijker om de prijs vast te stellen; projecten en technische oplossingen werden uitgedrukt in termen van kubieke meters asfalt. In termen van agency theorie kan men stellen dat er een verschuiving in het belang van *moral hazard* naar *adverse selection*.

Het is belangrijk te benadrukken dat het in deze nieuwe situatie ook voor aannemers zelf lastig is om een prijs een prijs toe te kennen aan bepaalde risico's en niveaus van betrouwbaarheid. Een vraag gesteld door praktijkmensen -vooral in Nederland waar aannemers opmerken dat te hoge risico's overgedragen worden en/of te hoge beschikbaarheidsniveaus vereist worden- is in hoeverre de principaal betaalt voor een service of een stimulans voor betere prestaties nastreeft, en in hoeverre hij eigenlijk verzekering betaalt. Sommige van deze risico's kunnen beter ondergebracht en onderhandeld worden in andere markt -zoals de verzekeringsmarkt, daar aannemers zelf mogelijkerwijs (nog) niet in staat zijn om deze risico's te controleren. De overheid zou beter af

kunnen zijn door zelf een aantal van deze risico's rechtstreeks op zich te nemen en/of lagere niveaus van systeembeschikbaarheid te vereisen. Aan de andere kant reageren overheden met een geschiedenis van betaling van te hoge prijzen aan aannemers vaak door in de toekomst vergelijkbare contracten voor aanzienlijk lagere budgetten aan te besteden. Hierbij ontstaat een nieuw probleem. Aannemers, aangespoord om de hoge kosten van onbenutte capaciteit te voorkomen, accepteren mogelijkerwijs om deel te nemen in het aanbestedingsproces zelfs als het hun duidelijk is dat de winstmarges klein zijn of dat ze zelfs verlies zullen gaan maken. Dit bedreigt de ontwikkeling van de sector. Ook is het mogelijk dat aannemers biedingen doen onder de kostprijs, hopende dat verliezen in de toekomst terugverdiend kunnen worden door heronderhandeling of door juridische claims neer te leggen. In alle spelsessies is waargenomen dat in dit nieuwe systeem de meest succesvolle aannemers diegenen zijn die zich sneller aanpassen en de nieuwe voorwaarden van de uitnodiging tot inschrijving letterlijk nemen (ze trekken bijvoorbeeld toekomstige bonussen af van hun prijs en/of anticiperen ze de winsten die ze kunnen behalen door de zwakke punten van het contract te benutten). De minder succesvolle aanbieders zijn diegenen die hun bieding baseren op de traditionele manier van prijscalculatie gebaseerd op totale kosten plus winstmarge. In de praktijk blijken kleinere aannemers degenen te zijn die meer moeite hebben om zich aan te passen aan de nieuwe manieren van prijscalculatie voor hun biedingen.

De waarheid is dat, ongeacht of de overheid of de aannemer de verliezer is ,beide transacties suboptimaal zijn vanuit een maatschappelijk oogpunt omdat of quasi monopolitaire gelden worden betaald met belastingsgeld, of de toekomst van de private sector bedreigt wordt, terwijl vaak onproductieve juridische kosten gedragen dienen te worden door beide partijen. De rol van de overheid als een bewaker van publieke waarden en publieke financiën is tegenwoordig meer uitdagend dan ooit. In de nieuwe aanbestedingssetting versus de traditionele speelt opportunistisch gedrag een grotere rol, niet alleen voordat het contract gesloten wordt maar ook daarna, daar deze nieuwe contracten meer dan voldoende ruimte late voor toekomstige heronderhandelingen of juridische strijd.

Innovative contracten zijn door hun aard gedoemd onvolledig te blijven, hiermee de mogelijkheid van, of de noodzaak van, heronderhandeling van contractvoorwaarden in de toekomst en vereisen een andere set van strategieën om opportunistisch gedrag te beperken.

1. Nieuwe contracten gebruiken een andere wijze van stimuleringsregelingen. Innovatieve contracten zijn vaak vaste-prijs, of zogenaamde "lump-sum", contracten, waardoor de winnaar van het contract als enige voordeel ondervindt van zijn eigen kostenbesparingen. De wegbeheerder vergoed in feite geen kosten, maar betaald slechts een vast honorarium; de aannemer draagt bijna alle projectrisico's.

2. Het item dat gecontracteerd wordt is niet langer een fysiek "produkt" of een

oplevering van fysieke activa of faciliteit, maar een "service" en bovendien de beschikbaarheid van een dergelijke service gedurende een x aantal jaren.

3. Contracttermijnen van dit nieuwe type contracten zijn vaak langer, van 3 tot 5 jaar tot 30 jaar of meer.

Deze drie punten houden slechts in dat een substantieel hoger risico wordt overgedragen naar de private sector, waarvoor een eerlijke prijs vantevoren onderhandeld dient te worden. Innovatieve contracten markeren ook het begin van een nieuwe houding of manier waarbij aannemers op een afstand gemanaged worden, hetgeen betekent dat overheden in hun rol van klant minder mogelijkheden en autoriteit hebben om het proces te beïnvloeden of in een bepaalde voorkeursrichting te sturen. Nogmaals, veel meer aspecten dienen vantevoren besloten te worden dan bij traditionele contracten.

Samenvattend moeten wegbeheerders in hun nieuwe rol van kwaliteitsregelgevers, of op zijn meest netwerkbeheerders, nieuwe manieren vinden om om te gaan met nieuwe vormen van opportunistisch gedrag; terwijl ze de mogelijke kosten van aanvankelijke mislukkingen accepteren als onderdeel van het leerproces onderweg naar een nieuw evenwicht. Echter geduld en acceptatie van mislukkingen als noodzakelijke investeringen zijn niet voldoende om succes te verzekeren. Substantiële besparingen in tijd en geld kunnen bereikt worden indien gepaste investeringen worden gerealiseerd in de opleiding van personeel op alle niveaus -aanbestedingsbestuurders, contract managers en technici- en inspanning geïnvesteerd wordt in het anticiperen van zwakke punten van toekomstige contracten en de formulering ervan.

Verder onderzoek

Verder onderzoek en ontwikkeling van opleidingsinstrumenten die overheden ondersteunen in de succesvolle invoering en beheer van innovatieve contracten en dynamica van dergelijke contracten zijn dringend nodig om te voorkomen dat publieke waarden in het gedrang komen en de maatschappij veel te veel betaald als onderdeel van het leerproces. Gaming en andere simulatietechnieken bieden hierbij grote kansen, omdat deze praktijkmensen in staat stellen van hun fouten te leren zonder dat kosten gemaakt worden als gevolg van mislukkingen in de echte wereld. De eerste stap naar succes is het kweken van begrip in de hele organisatie dat deze nieuwe aanbestedingspraktijken een hele ander houding en vaardigheden vereisen; en een bewustzijn bij ambtenaren en aannemers dat ze te maken hebben of krijgen met problemen van een andere, meer dynamische aard.

Mónica A. Altamirano

About the author

Mónica Alejandra Altamirano was born to Guadalupe Altamirano on 26th July 1979 in Managua, Nicaragua and was the youngest of 4 brothers, Carolina, Augusto and Ricardo.

After her education at the Catholic school for girls of the Society of St. Teresa of Jesus in Managua, she was granted a full scholarship to study at Thomas More University. In 2000 she received a Bachelor of Engineering with honours in Industrial and Systems Engineering. Upon graduation and during her first years of work experience -first as research assistant and later as technical assistant of the Minister-; she has been involved in the whole development process of a new policy for basic education in Nicaragua, from the formulation and design until the implementation of it. The National Education Plan for 2001-2015 was prepared in cooperation with more than 3000 members of the education sector and the society in general. This is seen as the most comprehensive effort in many years to achieve consensus on a national issue.

In 2002, she received a UFP (University Fellowship Program) grant from NUFFIC (Netherlands Organisation for International Cooperation in Higher Education) to study at Delft University of Technology. In August 2004 she obtained with honours her Master of Science (Systems Engineering, Policy Analysis and Management) degree from Delft University of Technology. Her Masters thesis was titled "Nicaraguan Basic Education System: Achieving Education for All by 2010" and was done in cooperation with the Nicaraguan Ministry of Education (MECD). Her thesis focused on the achievement of Education for All by 2015 -one of the Millenium Goals- and one that posed a technical and a political challenge to the Nicaraguan basic education system. The purpose of this research project was to provide the MECD with relevant information for two important processes. First, the process of designing the "shift" on education policy the country needs, which includes the allocation of priority status to each of the policy options that make part of the shift and which relate to the technical challenge. Second, the process of building political support for the educational reform to be implemented with enough ownership and success, which relates to the political challenge. The thesis work was developed within the Policy Analysis group under the supervision of Prof.dr.ir. W.A.H. Thissen, Dr.ir. C. van Daalen and Dr. W.M. de Jong.

In November 2004, she joined the Energy and Industry (E&I) group as a PhD researcher under the joint supervision of Prof.dr.ir. M.P.C. Weijnen and Dr.ir. P.M. Herder from E&I and Dr. W.M. de Jong from Policy, Organisation Law and Gaming (POLG). The research has resulted in the development of a lesson-drawing framework, which combines two elements. First, a comparative dynamic framework that serves as a guide for countries to evaluate if successful elements from practices elsewhere can be incorporated in their own regulatory regimes, contractual arrangements and practices. Second, a generic gaming-simulation tool that allows policy makers to experiment with different contract settings and incentives so as to arrive at the understanding needed to set the right incentives for contracts within their national institutional context. Research results have been published in international journals -such as the Transport Research Record-, edited books and refereed conference proceedings. The game simulation -Road Roles- has been played more than 14 times in the three countries studied. Eight of these sessions have been realized with professionals and experts in the area of innovative contracting. Her research was part of the Flexible Infrastructures research program of the Next Generation Infrastructures Foundation.

During her PhD years she conducted field research in Finland -with the cooperation of the Ramboll Group- and in Spain -with the cooperation of the Technical University of Navarra (TECNUN) and the Gipuzkoa Deputation in San Sebastian, Basque Country. She has also been a visiting scholar -following a variety of courses in system analysis, institutional economics, econometrics and regional economics- in Lund University and the Royal Institute of Technology, Sweden; Tinbergen Institute, the Netherlands and Université Paris I-Sorbonne, France.

Apart from carrying out her research, she coached many Master students on Continuous Modelling, System Dynamics and Cross-cultural Management; and supervised a Master project for a systems engineering student. Together with her peer group -Michiel Houwing, Bauke Steenhuisen and Martijn Jonker- she founded the TBM PhD mini-defences and in this way she collaborated to increase the frequency of open academic discussions within the faculty. Besides the academia, her old interest on community work in Nicaragua has found a place within the Delft International Student Chaplaincy. The International Student Chaplaincy offers to students: a home away from home; companion ship on the road of life; inspiration for personal growth; possibilities to cross borders of denomination, religion and culture and encounters with Dutch society.

She is married to Pepijn de Jong and has a daughter, Isabella (2009).

In January 2010 she joined the Scenarios and Policy Analysis unit of Deltares as medior policy analyst. She continues working on the topic of public procurement and contracting, risk sharing under innovative contracts, and has recently started to work on the environmental and sustainability aspects of construction and maintenance of roads infrastructure.

Deltares is a Dutch independent research institute for water, soil and subsurface issues. Deltares work on innovative solutions that make life in deltas, coastal areas and river basins safe, clean and sustainable. Deltares conduct research and provide specialist advisory services for government authorities and the corporate sector in the Netherlands and globally.

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Stellingen

behorende bij het proefschrift

Innovative contracting practices in the road sector
Cross-national lessons in dealing with opportunistic behaviour

Mónica A. Altamirano, 11 mei 2010

1. Onder de huidige innovatieve contractvormen blijft innovatie beperkt tot procesgerelateerde innovatie in plaats van technologische innovatie.
   [dit proefschrift]

2. Niet alleen de handelswijze van aannemers vormt een uitdaging voor de stabiliteit van regelgeving en de doeltreffendheid van stimuleringsmaatregelen, maar ook het strategisch gedrag van overheden.
   [dit proefschrift]

3. Doordat nationale wegbeheerders in toenemende mate afhankelijk zijn van ingenieurs- en adviesbureaus, en ze een toenemende vraag naar geïntegreerde projectoplevering smethoden hebben, zullen ze een nieuwe afweging tussen efficiëntie en integriteit moeten maken.
   [dit proefschrift]

4. Het gunnen van meer flexibiliteit en ontwerpruimte aan aannemers resulteert in een proces van aanzienlijke marktconcentratie.
   [dit proefschrift]

5. Door de gemiddelde eigenschappen van een populatie (in termen van nationaliteit, cultuur, religie, politieke voorkeur, etc.) toe te dichten aan personen die onderdeel zijn van die populatie wordt het individu per definitie verkeerd beoordeeld.

6. Vooroordelen zeer meer bevordelijk voor het proces van multiculturele integratie dan onverschilligheid.

7. Spiritualiteit is als muzikale vorming; het is gemakkelijker om zich ervan te ontdoen dan het zich in een later stadium eigen te maken.

8. Een duurzame relatie tussen partners kan niet zonder conflicten gevestigd worden.

9. Vrouwen zijn meer competitief onder vrouwen dan mannen onder mannen.

10. Het bewijzen van het bestaan van God door *intelligent design* is net zo zinloos als Zijn bestaan te weerleggen door middel van wetenschap.

Deze stellingen worden verdedigbaar geacht en zijn als zodanig goedgekeurd door de promotoren Prof. dr. ir. M.P.C. Weijnen, Prof. dr. ir. P.M. Herder en Prof. dr. W.M. de Jong.

Propositions

accompanying the thesis

Innovative contracting practices in the road sector
Cross-national lessons in dealing with opportunistic behaviour

Mónica A. Altamirano, May 11th, 2010

1. Under the current innovative contracting scheme innovation is limited to process-related innovation rather than technological innovation.
   [this thesis]
2. The stability of rules and effectiveness of incentives is challenged not only by the conduct of contractors but also by the strategic behaviour of government authorities.
   [this thesis]
3. In their reliance on engineering and consultancy firms and their increasing demand for integrated project delivery methods, national road authorities have to make a new trade-off between efficiency and integrity.
   [this thesis]
4. Increased flexibility and design space granted to contractors results in a process of significant market concentration.
   [this thesis]
5. In ascribing the median properties of a population (in terms of nationality, culture, religion, political party, etc.) to the persons part of that population, the individual is misjudged by definition.
6. Prejudices are more conducive to the process of multicultural integration than indifference.
7. Spirituality is as musical formation; it is easier to discard it than to adopt it at a later stage.
8. A sustainable relationship between partners cannot be established without conflicts.
9. Women are more competitive amongst women than men are amongst men.
10. Proving God's existence through *intelligent design* is as pointless as disproving His existence through science.

These propositions are considered defendable and as such have been approved by the supervisors Prof. dr. ir. M.P.C. Weijnen, Prof. dr. ir. P.M. Herder, and Prof. dr. W.M. de Jong.

Mónica Altamirano

Innovative Contracting Practices in the Road Sector

Cross-national lessons in dealing with opportunistic behaviour

Over the past fifteen to twenty years, the world has seen a proliferation of innovative approaches for the delivery and financing of public services, such as Public-Private-Partnerships (PPPs). Expectations in the road sector are high: more contract flexibility, more innovation, higher performance and consequently lower costs, while keeping up service levels on mobility, safety and the environment. But how successful have road authorities actually been in implementing such innovative arrangements?

This book answers the question by investigating how different national road administration authorities have implemented innovative arrangements and with what consequences. In addition, by developing and playing the serious game "Road Roles", the introduction of innovative arrangements was simulated multiple times in various settings. The results were alarming: the expected benefits with regards to cost and innovation do not materialize, and new forms of opportunistic behaviour were observed, resulting for example in uneven risk distributions between road authorities and contractors.

Lessons are drawn for road authorities around the world that are considering to implement innovative financing and project delivery approaches. This book, therefore, is a must-read for road authorities and contractors that want to reap the fruits of innovative approaches without experiencing the drawbacks of opportunistic behaviour.

The Next Generation Infrastructures Foundation

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